CHILDREN'S UNDERSTANDING OF THE MIND AS AN ACTIVE INFORMATION PROCESSOR: IMPLICATIONS FOR SUGGESTIBILITY

By

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Abstract of Dissertation Presented to the Graduate School of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

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This research examined predictions of a developmental model specifying relations between reductions in suggestibility and preschoolers' emerging "theory of mind." Three- to 5-year-olds witnessed an event and, following a short delay, answered questions about specific episodes. The interviewer suggested information to children that did not occur. One week later, children completed a forced-choice recognition test to assess their memory for the event, and a set of "theory of mind" tasks assessing their ability 1) to understand that knowledge requires a previous informative experience with the known object or event; 2) to understand the specific ways in which knowledge is acquired through experience (e.g., seeing or hearing); 3) to reason about conflicting mental representations relating to different claims about the way the world really is; and 4) to understand that people's representations are based on existing knowledge through

which their experiences are interpreted. The results showed that children's memory reports were equally accurate regardless of whether or not they had been misled. An increase in theory of mind performance was related to reductions in suggestibility after controlling for age; however, theory of mind performance did not predict suggestibility after controlling for children's general ability to remember the details of the original event. Further analyses showed that an understanding of the mind mediated both the accuracy and speed with which children reported their memories. Representational skills were particularly important for resisting suggested information for those children who demonstrated poor general memory for the original memory when they were not misled. Response time measures provided partial support for the prediction that children who are able to reason about conflicting mental representations require more time for mental processing because they consider their original memory of the event in conjunction with their memory of the suggested information. The response times of children who were unable to reason about conflicting mental representations indicated that these children may "update" their original memory of the event to be consistent with the suggested information, and thus choose the incorrect item on the test quickly, without considering their memory of the original episode.

REVIEW OF LITERATURE

Many jury members, psychologists, and legal professionals believe child witnesses to be more suggestible than adults (Goodman, 1984; Goodman, Bottoms, Herscovici, & Shaver, 1989; Goodman, Aman, & Hirschman, 1987; Leippe, Brigham, Cousins, & Romanczyk, 1989). Research on the suggestibility of young children reveals an inconsistent picture, with some findings indicating that younger children are no more suggestible than older children and adults and other studies showing that young children are more easily misled (for reviews see Ceci & Bruck, 1993, 1995; Toglia, Ross, Ceci, & Hembrooke, 1992; Zaragoza, Dahlgren, & Muench, 1992). These discrepant findings are attributable, in part, to procedural variations including the types of events children are asked to remember, whether children participate or observe the event to be recalled, the types of questions the interviewer asks (e.g., open-ended questions versus specific probes), the duration of the event, the amount of delay between the event and the presentation of misleading information, and the amount of delay between the event and the final report. Most studies have been performed with children older than preschool age. However, based on the research available with younger samples, most researchers agree that 3- to 4-year-olds are more vulnerable to reporting suggested information in comparison to older children (e.g., Ceci & Bruck, 1993; Goodman, Quas, Batterman-Faunce, Riddlesberger, & Kuhn, 1994; Toglia et al., 1992; Zaragoza et al., 1992).

Much of the previous work on children's suggestibility has been descriptive in that children's errors have been documented as a function of age and contextual manipulations without focusing on the mechanisms that underlie developmental changes in the resistance to misinformation. Theoretical models are needed in order to provide a basis for making generalizable claims regarding the existence and scope of developmental suggestibility effects and for making predictions in future research. In the present research, an extension of a standard method for assessing the influence of misleading information on memory reports was employed to provide evidence relevant to a model that may be useful for explaining children's developing resistance to suggestive questioning. The paper begins with a discussion of current hypotheses that have been put forth to explain the cause of suggestibility effects in both children and adults. This discussion is followed by an outline of a theoretical model that specifies relations between developmental changes in suggestibility and children's emerging understanding of the mind as an active, representational information processor.

Current Explanations of Suggestibility

Variations of a standard 3-phase procedure developed by Loftus and her colleagues (see Loftus, 1979; Loftus, Miller, & Burns, 1978) have been used widely in the study of suggestibility with both children and adults. In the original procedure (Loftus et al., 1978), adults viewed a film that served as the witnessed event. Following the film, viewers in the experimental group were asked misleading questions concerning the witnessed details. The remaining participants in the control group were not misled.

Memory for the original event was assessed using a forced-choice recognition test in which participants chose between the original item and the suggested information. Many replications of this procedure have been performed with participants ranging from age 3 to adulthood. These studies have involved a variety of stimuli (e.g., pictures, stories, films, live events), methods of presenting the misinformation (e.g., written narratives, misleading interviews), and varying delay intervals among the three phases. The findings show that individuals who are misled are more likely than control participants to "remember" suggested information in place of the originally witnessed episode (e.g., Ceci, Ross, & Toglia, 1987; Chandler, 1989, 1991; McCloskey & Zaragoza, 1985; Toglia et al., 1992; Zaragoza, McCloskey, & Jamis, 1987). This phenomenon is known as the "misinformation effect" and has been shown to be particularly strong for 3- and 4-year-olds (Ceci et al., 1987; Toglia et al., 1992, but see Zaragoza et al., 1992, for a failure to replicate).

Much debate has transpired regarding the nature of the misinformation effect. Misinformation effects may be greater for young children than for older children and adults because younger children encode weaker traces of the original event as a function of limitations on capacity, general knowledge base, or ability to learn (Howe, 1991; Howe & Brainerd, 1989; Marche & Howe, 1995). Thus, suggested information may "fill-in-the-gap" left by an initial failure to encode the original episode (McCloskey & Zaragoza, 1985). Further, younger children forget information more quickly than older children, after controlling for developmental differences in encoding (Brainerd, Reyna, Howe, &

Kingma, 1990; Howe & Brainerd, 1989). Therefore, younger children may be more likely than older children to accept suggested information because they have forgotten the original details. For example, in one study, 5- to 7-year-olds witnessed an event either once or repeatedly until their memory performance reached a set criterion (Howe, 1991). Children who witnessed the event once were more likely to be misled than children who witnessed the event repeatedly. However, misinformation effects also occurred as a function of forgetting among those children who reached criterion levels of encoding. Thus, whenever children either fail to encode or retain the original information, they appear to "remember" the information suggested by an interviewer.

Children may report suggested information because, after the original event is encoded, it is "overwritten" or "updated" following exposure to misleading information that contradicts the original detail. According to this view, memory for the original event is replaced or irreparably altered in storage by a memory for suggested information (Loftus, 1979; Loftus & Loftus, 1980). However, young children sometimes report the original item in addition to the suggested detail, showing that they retained the original information after they were misled (Ackil & Zaragoza, 1995; Marche & Howe, 1995).

Alternatively, researchers have proposed retrieval explanations for suggestibility effects whereby both the original and suggested information are remembered, but during retrieval, access competition between the two memory traces renders the weaker memory trace irretrievable (Bekerian & Bowers, 1983; Christiaansen & Ochalek, 1983; Lindberg, 1991). Retrieval-based explanations for the misinformation effect that take into account

the quality of the remembered information in addition to the strength of memory traces have strong empirical support (Ackil & Zaragoza, 1995; Belli, Lindsay, Gales, & McCarthy, 1994; Lindsay, 1990; Lindsay & Johnson, 1989; Weingardt, Loftus, & Lindsay, 1995). For example, according to the source monitoring model (see Johnson, Hashtroudi, & Lindsay, 1993; Johnson & Raye, 1981; Lindsay & Johnson, 1987), differences in the qualitative characteristics of event memories provide cues that individuals use to determine the particular origin of a single memory or to distinguish the sources of two event representations. The reporting of suggested information may occur because individuals ineffectively examine their stored memory representations for source cues, resulting in confusion between memories of original and suggested episodes.

Research with adults shows that participants who receive explicit instructions to attend to the sources of their memories are less suggestible than participants who do not receive such instruction (e.g., Lindsay & Johnson, 1989). Conversely, experiencing events in contexts that make it difficult for individuals to distinguish the sources of their memories (e.g., witnessing an event and hearing misinformation in the same setting, which results in memory representations with fewer distinguishing cues) leads to source confusion and the reporting of misleading information (Lindsay, 1990).

Developmental improvements in the ability to monitor the sources of memories may help to attenuate suggestibility during early childhood (Ackil & Zaragoza, 1995; Lindsay & Johnson, 1987). Most studies of source monitoring have been performed with children older than preschool age. These studies show that 6- to 10-year-olds had more

difficulty than adults discriminating memories of actions they performed from memories of actions they imagined performing, and more difficulty discriminating memories of what another person did from what they only imagined that person doing (Foley & Johnson, 1985; Lindsay, Johnson, & Kwon, 1991). However, 6-year-olds were as able as older children and adults to distinguish memories of what they said and did from memories of what they heard someone else say or do (Foley & Johnson, 1985; Foley, Johnson, & Raye, 1983) and memories of words from memories of pictures (Foley, Durso, Wilder, & Friedman, 1991). Thus, it appears that by age 6, children may be as able as adults to distinguish memories of events in which they participated or events they witnessed from memories of events they were only told about.

The few studies of source monitoring that have been performed with preschoolers show improvements in children's ability to distinguish among performed, pretended, and/or imagined actions (Foley, Harris, & Hermann, 1994; Roberts & Blades, 1995; Welch-Ross, 1995a; Woolley & Bruell, 1996). The three studies that have been published to date on children's ability to monitor the source of suggested information show improvements during early childhood in the ability to make accurate source attributions that lead to reduced suggestibility (Ackil & Zaragoza, 1995; Ceci, Huffman, Smith, & Loftus, 1994; Ceci, Loftus, Leichtman, & Bruck, 1994). Ackil and Zaragoza (1995) found that children reported information they witnessed in addition to the suggested information, indicating that they were confused about the sources of their memories. Further, first-graders more often than third- and fifth-graders believed they had actually

witnessed suggested information. In turn, older children made more source attribution errors than adults. In other research (Ceci et al., 1994), 3- to 6-year-olds were interviewed about a list of events, some of which parents reported their children had experienced and others that had not actually occurred. During an interview, children were encouraged to "think real hard" about each episode in order to judge whether or not they had experienced each one. Children were warned that some of the events had not really happened. In subsequent interviews, which were conducted at regular intervals across a 12-week period, 3- and 4-year-olds were more likely than 5- and 6-year-olds to report they had actually experienced the fictitious events. Many of the younger children proceeded to elaborate on the false episodes and to maintain that they had experienced the events even when their parents explained to them that the episodes had not really occurred.

In sum, adults make inaccurate source attributions and evidence suggests that they can come to believe they have actually experienced episodes that were only suggested to them (e.g., Belli et al.,1994; Weingardt et al., 1995). Yet, changes clearly take place during early childhood in the ability to distinguish the sources of memories, with much improvement occurring before age 6 in the ability to make particular kinds of source attributions that may be critical for distinguishing experienced and suggested events.

Rather than focusing on memory failures for explanations of misinformation, other researchers emphasize that participants may encode, store, retrieve, and distinguish the source of their memories of the original event but choose the suggested item because they

acquiesce to the perceived authority or knowledge of the interviewer (McCloskey & Zaragoza, 1985; see Zaragoza et al., 1992). To test this hypothesis, McCloskey and Zaragoza modified the original procedure developed by Loftus et al. (1978). In this modified procedure, participants who are misled must chose between the original item and an entirely new piece of information. The suggested information is not an option in the modified test, thereby alleviating any social pressure to choose it. The underlying assumption of this procedure is that, if exposure to suggested information impairs memory for the original episode, then the misled participants should choose original and suggested information equally often. Their preferred choice--the suggested item--cannot be selected and therefore they must guess between the only alternatives available. Thus, the misled group should not show a preference for either the original item or the new item if they have truly forgotten the original information. In contrast to the misled group, participants in the control group would be expected to choose the original detail more often than the suggested item.

Results of studies using the modified test with both children and adults show that both misled and control groups more often choose the original detail instead of the new item. Further, misled participants in the modified procedure, for whom the suggested item is not an option, choose the original item more often than do misled participants in the standard test. Thus, at least part of the misinformation effect appears to be a function of perceived pressure to choose suggested information (but see, Loftus, Hoffman, & Wagenaar, 1992, for alternative views).

Presumably, young children would be more susceptible to social pressure than would older children and adults. When interviewed by an experimenter, young children (and sometimes adults) give answers to nonsense questions such as "Is milk bigger than water?" (Hughes & Grieve, 1980; Pratt, 1991). Also, younger children are more likely than older children to change their memory reports after repeated questioning, presumably because the repeated question leads children to infer they must have provided an inaccurate response to the question the first time it was asked (Siegal, Waters, & Dinwiddy, 1988).

Suggestibility effects associated with the dynamics of the social exchange between children and interviewers also appear to vary with age. For example, in one study using a two phase procedure, children witnessed an event and then were interviewed about the details (Goodman, Rudy, Bottoms, & Aman, 1990). Three- to 4-year-olds were less likely to be misled by a "nice" interviewer who gave them cookies and juice, smiled frequently, and provided encouraging feedback regardless of the accuracy of children's answers, than by a "not-so-nice" interviewer who did not provide a snack, maintained a more neutral demeanor, and did not provide encouragement. In contrast to younger children, 7-year-olds provided equally accurate information to both interviewers, confirming that suggestibility effects related to certain social factors decrease with age.

The social acquiescence explanation for developmental misinformation effects was supported in one study in which both the original and modified procedures were employed with 3-year-olds, 6-year-olds, and adults (Ceci et al., 1987). Three-year-olds who were

interviewed by a 7-year-old child displayed less of a misinformation effect than did children who were interviewed by an adult. However, 3-year-olds still showed a greater misinformation effect than older children after accounting for effects associated with social pressure, indicating that social acquiescence does not account entirely for age differences in the misinformation effect.

To summarize, developmental changes in social acquiescence and memory processes including encoding, storage, and source monitoring all appear to influence degree of suggestibility. However, the relative and interactive contributions of memory and social influence factors, and the situational mediators of their effects, are yet to be determined.

The Active-Mind Model of Suggestibility

Previous research has focused on cognitive factors relating to memory and social influences pertaining to acquiescence for explaining developmental differences in suggestibility effects. However, developmental changes in preschoolers' social-cognitive skills that may operate to attenuate the reporting of suggested information during early childhood are unexplored. Consider that the forensic interview is a type of social exchange in which children must bring to bear their ability to evaluate their own knowledge of a past event, the interviewer's knowledge of that same event, and, in the case of misleading questions, the contradiction between what an interviewer may suggest to be reality and what the child knows is really the case. When attempting to explain developmental differences in suggestibility, we must determine if children's ability to make

sense of this social interaction, involving knowledge claims and contradictory representations of events, affects the degree to which children report suggested information.

Within recent years, much theorizing and research has contributed to our knowledge about children's changing conceptions of the mind. This work indicates that, during the preschool years, children develop a theory-like understanding of the mental world (see Astington, Harris, & Olson, 1988; Perner, 1991; Wellman, 1990). This "theory of mind" is an integrated set of hypotheses about how the mind works and is used for comprehending, explaining, and predicting people's behavior. Research suggests that the nature of children's understanding of the mind changes as preschoolers experience a transition from having a "copy theory of mind" (Chandler & Boyes, 1982) to possessing an active, representational theory of mind (Astington & Gopnik, 1988; Flavell, 1988; Perner, 1991; Wellman, 1990).

Based on the active-mind model of suggestibility proposed in this research, four developmental steps in children's changing conceptions of the mental processes of knowing and believing are most relevant to explaining suggestibility effects: 1) an understanding of a general mind-world connection, or that the mental state of knowing is linked to some kind of previous informative experience with the known object or event; 2) an understanding of specific mind-world connections, or of the specific ways in which one's knowledge is acquired through experience (e.g., via seeing, feeling, hearing); 3) an understanding that the mind represents the world, and thus a single object or event can be

represented differently from the way the world really is, can be represented differently by two people simultaneously, or can be represented in different ways by the same person at two points in time; and 4) an understanding that people's representations are based on their existing knowledge through which their experiences are interpreted (for a review see Flavell, Miller, & Miller, 1993).

General Mind-World Connections

During the preschool years, children begin to understand the meaning of knowledge--that knowing requires having access to relevant information (Flavell, 1988; Pillow, 1989; Pratt & Bryant, 1990; Ruffman & Olson, 1989; Taylor, 1988a. 1988b; Wimmer, Hogrefe, & Perner, 1988). Before about age 5, children do not fully understand this connection between information access and knowledge. Rather, young preschoolers seem to attribute knowledge based on experiences such as a person's desire to have a particular piece of information (Montgomery & Miller, in press), or on the successful performance of a goal-directed action, for example, a person's lucky guess as to where an object is hidden when the person had no information about where the object actually was (Moore, Bryant, & Furrow, 1989; Miscione, Marvin, O'Brien, & Greenberg, 1978; Perner, 1991).

However, 4-year-olds do have a partial understanding of knowing. Four-year-olds, but not 3-year-olds, are aware that someone who has looked inside a container knows its contents whereas someone who has not looked does not know what is inside (Pillow, 1989; Pratt & Bryant, 1990; Ruffman & Olson, 1989; Wimmer et al., 1988).

Similarly, Taylor (1988a) showed children a picture of a giraffe and an elephant, and then the children watched as a puppet viewed an "empty" part of the picture in which neither the giraffe nor the elephant was shown. Many 4-year-olds, but none of the 3-year-olds, recognized that the puppet could not know the identity of the animals based upon seeing the blank portion of the picture.

Although 4-year-olds understand some aspects of the connection between experiencing and knowing, 6-year-olds are beginning to demonstrate a more complex understanding, namely that one needs complete and unambiguous information in order to have knowledge (Chandler & Helm, 1984; Taylor, 1988a, 1988b but see Perner & Davies, 1991 and Ruffman, Olson, & Astington, 1991, for evidence that children understand ambiguity at about age 4). For example, in Taylor's (1988a) study, children watched further as a puppet viewed an unidentifiable portion of one of the animals. All 3- year-olds, but less than half of the 6-year-olds, believed that the puppet could identify the animal based upon access to incomplete information. Their responses were derived from their basic understanding that access to information leads to knowledge; however, younger children seem to consider any type of experience to be adequate for knowing. In contrast to younger children, 6-year-olds realized that not all experiences are equally informative. Similar results have been found regarding other visual (Ruffman et al., 1991) and auditory stimuli (Miller & Bigi, 1977; Mossler, Marvin, & Greenberg, 1976; Sodian, 1988, 1990). As in visual tasks, by about age 6, children understand that the recipient of

ambiguous verbal messages will not know the content of the communication (e.g., Sodian, 1990).

With respect to the attenuation of misinformation effects, an understanding of a general mind-world connection may contribute to children's ability to resist suggestion by enabling them to become more certain in their judgments about who knows and who does not know about a particular event in question. Children should be more certain about their own memory reports because they know that they, and not the interviewer, personally experienced the event and as a result, they, and not the interviewer, have access to the information necessary for knowing about it.

Research shows that adults are more likely to be misled by an interviewer they were told was highly knowledgeable about a witnessed event rather than by an interviewer they were told was naive (Smith & Ellsworth, 1987). Toglia et al. (1992) used a similar procedure to manipulate the credibility of an interviewer in a study with 4- and 8-year-olds. In this research, a story served as the witnessed event. Before interviewing children about the story, the knowledgeable interviewer told them that s/he knew the story "real well," read it to children "all the time," and that it was one of the interviewer's "favorite stories." The naive interviewer told children that s/he did not "remember very much" about the story because s/he had not "read it in a long time." Both 4- and 8-year-olds were more likely to be misled by the knowledgeable interviewer than by the naive interviewer. Thus, 4-year-olds recognized that the knowledgable interviewer was more credible, based on the interviewer's prior access to the details of the event. The

performance of 4-year-olds in this study was particularly striking, because the manipulation of credibility in this studied involved varying the amount and recency of the interviewer's information access. The theory of mind literature indicates that the ability to attribute knowledge based on varying degrees of access to relevant information may develop later than the ability to attribute knowledge based on whether a person either did or did not have access (see Astington, 1993). Importantly, however, research on children's theory of mind shows that it is between ages 3 and 4 that children greatly improve in the ability to understand that at least some kind of information access is important for knowing. Thus, previous research on children's suggestibility and theory of mind indicates that as young children become aware of the conditions of information access through which individuals acquire knowledge, they should be able to resist suggestive questioning better than children who may still believe that the interviewer could be as knowledgeable about the event as they.

Specific Mind-Word Connections

Although some 3-year-olds and most 4-year-olds recognize that informative experiences are linked to knowing, children only later seem to connect their knowledge to specific experiential origins (Gopnik & Graf, 1988; O'Neill & Gopnik, 1991). For example, O'Neill and Gopnik (1991) allowed 3- to 5-year-olds to discover the contents of a drawer by looking inside the drawer, by listening as researchers told them what was inside, and by inferring the contents based on a clue the experimenter provided. In an immediate test, all children could name the object inside the drawer. However, when

asked how they knew what was inside, only 5-year-olds were able to determine the origin of their knowledge more often than would be expected from guessing (see also Gopnik & Graf, 1988). The same finding holds regardless of whether children are asked about the sources of their own knowledge or about the sources of another person's knowledge. For example, in a similar study, 3-year-olds could not determine who was likely to know the color of a hidden ball--a person who looked inside a tunnel to see the ball or a person who reached inside to feel it (O'Neill, Astington, & Flavell, 1991).

Importantly, these findings are not simply a function of age differences in short-term memory performance because the same findings obtain whether children are asked to explain how a person acquired knowledge or to predict what future action a person would have to take to obtain a particular piece of information. For example, 3-year-olds do not know that a person would have to see an object to know its color and feel an object to know its texture. Rather, they just as often assert that feeling the ball leads to knowing its color (O'Neill et al., 1991; see also Perner & Ruffman, 1995; Pillow, 1993).

A developing understanding of specific mind-world connections may be essential for engaging in the process of source monitoring which has been shown to play a critical role in reducing misinformation effects. Studies with adults clearly show that the opportunity to carefully consider the sources of one's memories fosters resistance to suggested information. As noted earlier, by age 6, children can distinguish between memories of words and memories of pictures and can distinguish memories of what they themselves did or said versus what they saw someone else say or do (Foley & Johnson,

1985; Foley et al., 1983; Lindsay & Johnson, 1987). However, improvements occur during the preschool years in the ability to make accurate source attributions (e.g., Blades & Roberts, 1994; Foley et al., 1994; Lindsay et al. 1991; Welch-Ross, 1995a; Woolley & Bruell, 1996). Thus, research on source monitoring clearly implies that preschoolers may be more suggestible either because they do not encode source information or because they do not effectively examine their memory representations for source cues. Lindsay and Johnson (1987) suggest that some kind of metacognitive awareness may be necessary for source monitoring, but the nature of this metacognitive understanding has not been specified.

Based on the proposed model, children's understanding of specific mind-world connections may be a metacognitive skill that enables them to encode information relating to the specific experiential source of an event and/or to examine their representations of events for source cues during retrieval (see also Woolley & Bruell, 1996, and Zaragoza et al., 1992). Preliminary evidence supports this relation between children's understanding of specific mind-world connections and the ability to make accurate source attributions (Welch-Ross, 1996a). In this study, 3- to 5-year-olds performed, imagined performing, and pretended to perform a set of actions. After a 5-minute delay, children were asked to recall the source of their memories for each action. One week later, children's ability to identify the origins of their knowledge was assessed using a procedure adapted from O'Neill and Gopnik (1991). Children who were able to connect their knowledge to a specific informative experience were better able to determine the origin of their memories

for the performed, pretended, and imagined actions. These data, in conjunction with studies documenting a) the relation between source monitoring failures and misinformation effects and b) the development of source monitoring skills in early childhood, clearly suggest that children who do not connect knowing to particular informative experiences may either fail to encode source information or fail to examine their mental representations for source cues, thereby impeding the source monitoring process which is known to reduce misinformation effects.

Conflicting Mental Representations

Consider that misleading information is put forth as a competing representation of an event for which the child already has a representation. Even if children can remember their original representation of an experienced event, a failure to consider that representation in light of conflicting information may contribute to misinformation effects and to what appears to be an "overwriting" phenomenon. During the preschool years, children begin to understand that the mind is not only connected to the world, but that it represents the world. They begin to consider that a person's representation may differ from the way the world really is and thus two people may represent the world differently or one person may represent the world differently at two points in time. The weight of evidence suggests that young preschoolers are unable to conceptualize multiple, conflicting representations of a single reality (Astington, 1993; Flavell, Green, & Flavell, 1986; Gopnik & Astington, 1988; Gopnik & Slaughter, 1991; Perner, 1991; Wellman, 1990). In fact, children's performance on tasks presumed to index their understanding of

the active mind is strikingly similar to the "updating" phenomenon hypothesized to occur following exposure to misleading information.

In one such task, known as the "representational change" task (Gopnik & Astington, 1988; Gopnik & Slaughter, 1991; Perner, Leekam, & Wimmer, 1987), children are shown a crayon box and asked what they think is inside the box. After saying they believe crayons to be inside, they are allowed to look at the contents to discover that candles are inside the box. When asked what they had previously thought was inside, when they had first seen the closed box, 3-year-olds reported that they had believed candles to be inside. Their original representation of the contents appeared to be "overwritten" to match reality.

Just as 3-year-olds seem unable to acknowledge that their own representations may conflict with reality, they also seem unable to recognize that someone else can experience a false belief, or represent the world differently from the way it really is (e.g., Wimmer et al., 1988; Wimmer & Perner, 1983). In one task, a story is acted out with dolls in which a boy puts chocolate in a green cupboard and goes outside to play. While he is outside, the boy's mother removes the chocolate and puts it in a blue cupboard. The boy returns to the room and the participant is asked where the boy will look to find the chocolate. Three-year-olds believe the boy will look in the blue cupboard for the chocolate, even though he could not know its actual location. Most 5-year-olds do not make this error (see Astington, 1993, for a review).

Given that young preschoolers have similar difficulties when reasoning about their own conflicting mental representations, their performance on false-belief tasks does not seem to stem from problems with perspective-taking, such that they fail to consider someone else's view of a situation simultaneously with their own (for further discussion see Astington, 1993; Astington & Gopnik, 1988; Perner, 1991; Wimmer et al., 1988). Rather, a source of young children's poor performance seems to be their difficulty in reasoning about conflicting truth-claims pertaining to reality (Flavell, 1988; Perner, 1991). For example, 3-year-olds can predict where the character will look for the chocolate if the they do not know themselves where the candy is, or if the candy is in both locations (Wellman & Bartsch, 1988). In these situations, however, no conflict occurs between the child's representation of the real situation and the other person's representation of the situation which conflicts with reality. Moreover, 3-year-olds' performance sometimes improves if they are told the true location of the candy instead of seeing it (Zaitchik, 1991). Similarly, 3-year-olds perform better on representational change tasks if they are told what is really inside the box instead of seeing for themselves. However, these manipulations may improve performance by making the conflict less salient, thereby allowing them to reason more effectively about the two representations.

Finally, converging evidence of preschoolers' difficulty with reasoning about conflicting mental representations comes from research on their understanding of appearance/reality distinctions (Flavell, Flavell, & Green, 1983; Flavell et al., 1986; Harris, Donnelly, Guz, & Pitt-Watson, 1986). For example, in one task children are presented

with a sponge painted to look like a rock. Then, they are allowed to pick up and squeeze the sponge. When asked what the object really is and what it looks like to their eyes, 3-year-olds typically report that it both really is a sponge and looks like a sponge. Thus, not until age 5 do children seem able to consider simultaneously a representation of the object itself and a representation of what the object appears to be. Performance on representational change, false-belief, and appearance/reality tasks is positively correlated independent of age, indicating they may index an emerging ability to reason about conflicting mental representations (Astington & Gopnik, 1988; Gopnik & Astington, 1988).

Although children may be unable to reason about conflicting representations relating to beliefs and perceptual illusions, Custer (1996) demonstrated that children may reason precociously about conflicting representations of events within the context of remembering and pretense. In this research, 3-year-olds were presented with three versions of a story corresponding to the mental states of pretense, memory, and false-belief. For example, one character was portrayed as sitting on a bank fishing. The character was described in the three story versions as pretending to catch a fish on the line when actually there was a boot on the line, remembering having caught a fish on the line when at the present time there was a boot on the line, or believing a fish was on the line when actually a boot was on the line. Therefore, in all of the story versions the real, present, or actual state of reality was that a boot was on the end of the character's fishing line. For each scenario, children were asked which of two "thought bubbles" matched the

character's thoughts--the "thought bubble" depicting the reality or the one depicting the character's mental representation of the pretense, memory, or false belief. Three-year-olds were able to choose the picture that corresponded with the mental state of the character in both the memory and pretense conditions, but were less able to do so in the false-belief condition. This pattern of results suggests that children may be able to reason about two conflicting representations within the context of remembering earlier than they can reason about false beliefs and appearance-reality distinctions, perhaps because the conflict does not involve conflicting truth-claims regarding a single, immediate situation.

In sum, 3-year-olds seem not to consider their previous representations in light of new, discrepant ones. Similarly, they may not consider their original memory representation in view of misleading information that contradicts their earlier experience. As a result, young children may be more likely than older preschoolers to report suggested information.

A recent study related to the "active mind" model of suggestibility supports a link between children's understanding of conflicting mental representation and the attenuation of misinformation effects (Welch-Ross, Diecidue, & Miller, in press). In this research, 3-, 4-, and 5-year-olds listened to a researcher read a story accompanied by pictures. After a 4-minute delay, a second researcher entered the room and asked straightforward questions (e.g., Did Sally feed her pet fish?) and misleading questions (e.g., Sally fed her pet dog, didn't she?) about the story. One week later, a third researcher asked children straightforward questions relating to the original episodes and suggested items. Following

the interview, children completed a set of theory of mind tasks, including appearance-reality tasks, representational change tasks, and tasks in which children made pretend-real distinctions. Children's scores on theory of mind tasks were combined into a composite measure intended to index their ability to reason about conflicting mental representations. Regressions showed that suggestibility (i.e., the number of questions children answered incorrectly at the second session relating to episodes about which they had been misled) decreased with an increase in conflicting mental representation scores. This relation remained significant after controlling for age and their memory for episodes about which they had not been misled.

The ability to consider conflicting representations may facilitate resistance to suggested information in two ways: 1) by allowing for a direct comparison of the source cues between memories of original and suggested information, and thus for distinguishing the sources of each representation, and 2) by enabling children to judge the relative truth-values of the two representations (to be discussed in the following section). First, research on the relation between discrepancy detection and suggestibility shows that both children and adults are better able to resist suggestion when given greater opportunities to detect conflicts between the suggested item and the witnessed episode. For example, adults who evaluated misleading and original information for longer periods of time were better able to detect discrepancies between the original event and suggested items. As a result, they were more resistant to reporting that the misinformation was part of the original event (Tousignant, Hall, & Loftus, 1986). Similarly, Lindsay (1990) found that

adults who witnessed an event and were presented with misinformation in similar settings were more likely than adults who witnessed an event and experienced misinformation in very different settings to report having actually witnessed the episodes that were only suggested to them. These results suggest that distinguishing the sources of two event representations is more difficult when there are fewer discrepancies between them.

Consider that 6-year-olds, but not 3- and 4-year-olds, are able to reason about conflicting mental representations of a single reality and are aware of specific mind-world connections. Thus, during the preschool years, children may become better able to represent their conflicting representations of an event and to distinguish the origin of each, thereby becoming less likely to report having witnessed the suggested information. Whereas adults in Lindsay's (1990) study were prevented from detecting discrepancies that gave clues as to the sources of their memories, young preschoolers may be unable to engage in the discrepancy detection process, because they have "updated" their earlier representations to maintain a single view of the way the world is.

Interpretation

In addition to providing children with the metacognitive skill necessary for detecting discrepancies between event representations, the ability to reason about conflicting mental representations together with an understanding of general mind-world connections may enable children to understand that a person's existing knowledge leads to the interpretation of incoming information. This understanding of interpretation could

have implications for children's ability to evaluate the relative truth-values of their representations of the witnessed event and the suggested information.

Preschoolers appear to have difficulty understanding that people's representations are interpretations of the world that are based upon their existing knowledge (Flavell et al., 1981; Perner et al., 1987; Pillow, 1991; Taylor, 1988a; Wimmer & Perner, 1983). For example, in one study, 4- and 5-year-olds were unaware that a puppet who previously viewed a picture of sharks would be more likely to interpret a triangle-shaped portion of a picture as belonging to a picture of sharks, rather than to a picture of a house--the full picture that the children themselves had viewed (Pillow, 1994). In other research (Pillow, 1991), 4-, 6-, and 8-year-olds listened to a story in which one story character, Mike, dislikes Tom because he thinks Tom is a mean person and typically gets into trouble. When Tom knocks Mike's airplane to the floor, breaking it into pieces, 6- and 8-year-olds understood that Mike would be more likely to believe Tom purposefully broke the airplane than would someone who had no prior knowledge of Tom's behavior. However, 4-year-olds attributed positive and negative interpretations randomly to people with and without prior knowledge.

Consider that children who understand the interpretive nature of representation have the metacognitive skill necessary for understanding the process through which a person may assign a truth-value, either positive or negative, to new information. As a result, they should be better able than children without such understanding to resist suggested information. Specifically, with an interpretive understanding of representation,

children can recognize that a) a person who is naive about an event would be less likely to resist false information because she lacks the experience of information access necessary to discern that the information is false, and b) a person who is knowledgable about an event, as a function of having had previous access to relevant information that conflicts with information provided by the interviewer, would be likely to reject false information. Thus, the ability of children to understand general mind-world connections, to recognize that prior knowledge determines how new information is interpreted, and to consider both representations simultaneously may help to attenuate suggestibility.

Evidence suggests that children's understanding of the mind as an interpreter of information is related to the ability to make precisely these kinds of judgments (Perner & Davies, 1991; Robinson, 1994). For example, in one study (Perner & Davies, 1991), children listened to one of four stories in which a character who was either naive or knowledgeable about the contents of a box received from another character either true or false information about its contents. Children between ages 4 and 5 years, but not 3-year-olds, realized that the character who looked inside the box would be more likely than the naive character to reject a false description of the contents. Even when the "knowledgeable" person who looked inside held a false belief because she had been tricked (i.e., by a fake rock inside the box that was really a sponge), older children predicted that the person who had looked inside the box and believed the sponge to be a rock would reject true information that the "rock" was really a sponge. Thus, during the preschool years, children come to understand that listeners would treat an utterance as relatively

unreliable in the face of their own perceptual experience, and that a particular input could be interpreted differently by listeners with different prior informative experiences.

Other studies show that, during the preschool years, children improve in their ability to judge the relative validity of conflicting information based on whether a person actually saw or was only told about the information (Robinson, 1994; Robinson & Mitchell, 1995). For example, they became better able to judge that a story character, Kevin, who saw orange juice in a container would disbelieve another character, Rebecca, when she told Kevin that there was milk inside. However, when Kevin had not seen the orange juice, children predicted that Kevin would be likely to believe Rebecca's assertion that milk was inside the container. Thus, preschoolers come to understand that people will be more likely to believe what they see first-hand, rather than conflicting information that is told to them.

Importantly, children in these studies did not know themselves whether there was really milk or juice in the container. Therefore, children were not constrained by their inability to reason about conflicting representations of events when reality was known to them personally as in false-belief, appearance-reality, and representational change tasks. In a related study, children saw for themselves whether juice or milk was in the container. Those children who performed well on false-belief tasks were more accurate than children who failed false-belief tasks in their judgments of what a character would believe after hearing the verbal information when the character either had or had not previously seen the contents (see Robinson, 1994; Robinson & Mitchell, 1995).

It is important to note that 4-year-olds' performance on false-belief tasks can be improved by highlighting a story character's lack of access to information regarding the transfer of chocolate between cupboards (Wimmer & Perner, 1983). However, making the character's lack of information about the location of the chocolate more salient does not improve 3-year-olds' performance (Moses & Flavell, 1990) even though many 3- to 4-year-olds appear to understand the connection between experiencing and knowing (e.g., Pillow, 1989; Pratt & Bryant, 1991). Thus, a firm understanding of interpretation appears to require a converging understanding of the relation between experience and knowledge (i.e., a general mind-world connection) and the ability to consider conflicting mental representations, as indexed by children's performance on false-belief, representational change, and appearance-reality tasks.

Together, these studies provide compelling reasons to expect a link between reductions in suggestibility between ages 3 and 6 and children's ability to interpret the validity of information involving conflicting truth-claims. In the context of a misleading interview, children are exposed to verbal messages that contradict information that they experienced directly. If children are able to understand that others will be more likely to reject messages that conflict with first-hand experience, then perhaps when asked to report details of a witnessed event, they also will be better able to judge the relative truth-value of representations of that originated from their own experience and conflicting representations that originated from the interviewer.

Summary

The present conceptualization of children's understanding of the mind as an active, representational information processor provides a developmental framework for making predictions regarding the relation between preschoolers' emerging representational understanding of mind and their developing resistance to suggestibility. Suggestibility may be reduced by following one of the "metacognitive" pathways shown in Figure 1, which depicts the on-line processing of information as a function of the child's acquisition of particular representational skills.

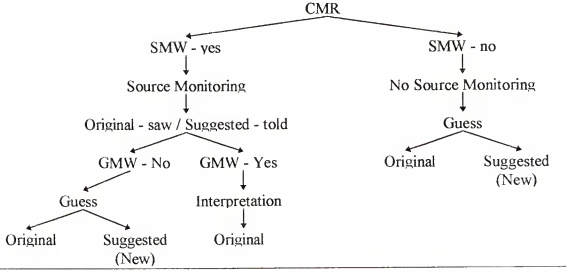

Figure 1 - The Active - Mind Model of Suggestibility

Note. CMR (Conflicting Mental Representation), SMW (Specific Mind-World Connection), GMW (General Mind-World Connection).

As children begin to reason about conflicting mental representations, they can examine their conflicting memory representations (i.e., the original event memory and the memory for suggested information) in order to discover cues by which to distinguish their

source. Research reviewed here with children and adults indicates that the opportunity to detect similarities and differences between memory representations facilitates source monitoring and reduces suggestibility. An understanding of specific mind-world connections may be a metacognitive skill that allows for the encoding of source information and/or the consideration of source cues during retrieval in order to distinguish between memories of original and suggested information.

An understanding that knowing is a mental state that arises from a general mind-world connection may attenuate misinformation effects by enabling children to ascertain whether they and others have knowledge of a particular event as a function of their exposure to a relevant previous experience. Further, children's understanding that knowledge is obtained via a general mind-world connection, in conjunction with their understanding of conflicting mental states, may enable children to understand that the mind interprets incoming information in view of previous knowledge. With this understanding, children may become able to judge the relative validity of their conflicting representations in light of their own information access and the interviewer's lack of access to the event. Thus, the greatest reduction in misinformation effects should occur when all of the capacities specified in the model are developed and utilized during suggestive questioning.

Testing the Model

As a first step toward testing the predictions outlined in the model, this research examined general relations between preschoolers' understanding of the representational

mind and reductions in suggestibility. Preschoolers listened to a story that served as the witnessed event. Following the story, they were asked misleading and straightforward questions about each episode. Memory for the event was assessed using three test conditions: 1) the Original Test (Loftus, 1979; Loftus et al., 1992), in which children chose between an original detail and a suggested episode; 2) the Modified Test (McCloskey & Zaragoza, 1985), in which children chose between an original detail and an entirely new item; and 3) the Control Test, relating to details about which children were not misled, in which they chose between an original detail and an entirely new item. Thus, the Control Test assessed general memory for the event following nonmisleading questions and provided a measure of children's general ability to encode and remember the details of the event.

Two questions were of primary interest in this research: 1) Is each type of representational understanding specified in the model related to reductions in suggestibility? 2) Do children consider conflicting representations of events when providing memory reports concerning events about which they have been misled? Regarding the first question, children's degree of suggestibility should be explained by their performance on tasks indexing their ability to 1) understand the general connection between information access and knowledge, 2) understand specific connections between particular experiences and knowledge, 3) reason about conflicting mental representations, and 4) understand that new information is interpreted with respect to previous

information. These relations were expected to remain significant after controlling for age and children's ability to remember the details of the event when they were not misled.

Alternatively, theory of mind performance may interact with children's memory for the event such that when children's event memory reaches high levels, representational understanding may not reduce suggestibility any more than children's good memory for the event can do alone. However, for children who demonstrate poorer memory for the event, representational skills may come to play a more important role in reducing suggestibility. The finding that representational skills may be more important when memory for the event is low rather than high would be expected because children who have weaker memory traces may be more likely to be misled by suggested information unless they can a) understand specific mind-world connections which may enable them to determine the source of the misleading information and b) evaluate the validity of their representation of the misleading information based upon the interviewer's knowledge of the event as a function of the interviewer's history of information access.

Reaction-time measures were collected during the recognition test to address the second goal of the study--to determine if children who are misled consider multiple representations of an event during the recognition task. Research based on information processing models of cognition with children and adults shows that mental processing time increases with an increase in the number of items processed and the complexity of the mental transformations performed (see Bashore, 1990, and Cerella & Hale, 1994). In the present research, response time measures were believed to be useful for determining the

number of memory representations individuals consider when discriminating whether a memory originated with a personally experienced event or from suggested information. This research is the first to examine differences in children's response times as a function of their suggestibility and their understanding of mind; however, developmental differences in response times have been examined using a variety of other cognitive tasks (see Cerella & Hale, 1994, and Kail, 1991, for reviews). In that research, children as young as age 3 understood instructions for completing reaction-time procedures in perceptual discrimination tasks (Kail, 1991). Studies involving 4- to 6-year-olds demonstrate that young children can perform reaction-time tasks that require higher level cognitive skills, for example picture and face recognition, selective attention, and sentence comprehension (Carter & Levy, 1988; Cerella & Hale, 1994; Ellis, Ellis, & Hosie, 1993; Kail & Park, 1992; McKee, Nicol, & McDaniel, 1993; Nettelbeck & Young, 1989; Wulfeck, 1993).

In the present research, children who were better able to reason about conflicting mental representations were expected to have slower response times in the Original and Modified test conditions that assessed children's memory for items about which they had been misled than in the Control test. This result was expected because when asked to choose between an original episode and suggested information or between an original episode and entirely new information after being misled, children who were able to reason about conflicting mental representation were hypothesized to require more time to consider two event memories -- one memory for the original event and one memory for suggested information. However, children who were less able to reason about conflicting

mental representations were hypothesized to have equivalent response-times across misleading and control conditions because they were expected to "update" their previous representations when they were misled, such that they consider only one event memory at the recognition test.

Note that this hypothesized outcome for response times is the opposite of what would be expected as a function of age-related changes in speed of mental processing. Clearly, older children are able to process information more quickly than younger children on a wide range of cognitive tasks (Cerella & Hale, 1994; Hale, 1990; Kail, 1991). Although few studies have been performed with very young children that assess processing time for searching memory, some findings indicate that the most dramatic developmental improvements in the efficiency of memory scanning occur before age 10 (see Cerella & Hale, 1994). Consider that older preschoolers are typically better able than younger preschoolers to reason about conflicting mental representations, and older children require less time for mental processing than younger children. Therefore, one possible outcome consistent with research on age changes in information processing is that children who are better able to reason about conflicting mental representations (typically older preschoolers) would respond more quickly on both the control and the misleading tests than children who are less able to reason about conflicting mental representations (typically younger preschoolers). However, the present model predicts that children who reason about conflicting mental representations, who were expected to be the older

preschoolers, would respond more slowly on the misleading test items than children who are less able to reason about conflicting mental representations.

Response times were also examined as a function of whether children provided correct or incorrect responses on the recognition test. The speed with which the incorrect item is chosen on the recognition test after the child has been misled may provide an assessment of how strongly the child believes in the inaccurate memory of the event (for a related discussion see Loftus, Donders, Hoffman, & Schooler, 1989). In the present study, among children who were inaccurate in the misleading test conditions, those children who were better able to reason about conflicting mental representations were expected to make their inaccurate choices more slowly than children who were less able to reason about conflicting mental representations. This result was expected because children with an understanding of conflicting mental representations may experience interference as they attempt to distinguish between their conflicting representations of the original and misleading information, whereas children without this representational understanding may consider only the incorrect representation they accepted from the interviewer and require less time to make their inaccurate response. Reaction times for inaccurate responding in the control condition were not expected to differ for children with high versus low understanding of conflicting mental representations. As in the above hypotheses for reaction time, this expected pattern of results is also the opposite of the findings that would be expected as a function of age-related changes in mental processing speed in that older children who are able to reason about conflicting mental representation

would be expected to respond more quickly than younger children who are typically less able to reason about conflicting mental representations.

This hypothesis was examined separately for the Original and Modified Tests. Children who are able to consider conflicting representations may experience conflict at both the Original and Modified Tests after having been misled regardless of whether or not the suggested item actually appears on the test. Therefore, they may have slower response times than children who cannot reason about conflicting representations when choosing inaccurately on both of the misleading tests. Alternatively, children who cannot consider conflicting mental representations may also have slow responses in the Modified Test in comparison to the Original and Control Tests because the suggested item, which they would have chosen quickly, is not among the items presented on the test. Thus differences in reaction time between children with different levels of understanding conflicting mental representation may be evident only for the Original Test Condition.

METHOD

Participants

Ninety 3-1/2- to 5-1/2-year-olds were recruited from three day care centers in North Central Florida. Thirty-three children were omitted from this sample because a) they did not follow the instructions for completing the memory task ($n = 21$), b) they were unable to complete the second session within the specified interval because of school absence ($n = 8$), c) the recognition test was interrupted by school staff ($n = 2$), d) an experimenter error led to the loss of data ($n = 1$), and mean response times during the recognition task were three times greater than the average obtained for the rest of the sample ($n = 1$). Thus, the final sample included 57 children ($M = 52.28$ months, range = 38 to 65 months, 24 males and 33 females).

Procedure

Equipment

Pictures of black and white line drawings were scanned into digital format and stored on the hard drive of a Gateway 2000 notebook computer These stimuli accompanied a story that served as the witnessed event and also were used for the recognition test.. A bold, black line separated the pictures within each pair of stimuli presented during the testing phase (see Appendix A). Two touch-sensitive buttons were connected to the external port and were attached with Velcro to the computer screen

immediately below each picture. Software developed for this study automatically displayed at regular intervals the pictures that accompanied the story and coordinated the collection of reaction-time and recognition accuracy data with the display of stimuli during the memory test.

Design

A within-subjects design was used in which all children participated in three test conditions: the Original Test in which children viewed a picture of the original story item and a picture of the suggested information; the Modified Test in which children saw the original story item and a picture of new information relating to an episode about which they had been misled; and a Control Test in which children viewed the original story item and a picture of new information relating to an episode about which they had not been misled.

Session one. The sessions were conducted by two female experimenters. Session one began with a pretest to ensure that children could follow the instructions for performing the reaction-time task. Experimenter 1 explained, "Today I'm going to teach you how to play a new game. First, I'm going to read a story to you. Look right here (pointed to screen) and play close attention so you can see the pictures that go with the story." Experimenter 1 read an 8-sentence story about the Lion King that was accompanied by pictures presented via computer. Each picture was displayed for 7 seconds. Immediately following the story, Experimenter 1 explained, "Now I'm going to show you some pictures. Each picture has its own black button, see? This picture has this

black button and this picture has that black button (experimenter pointed to each picture and its corresponding button). Which picture goes with the story we read? Right! So, punch the black button that goes with the story."

If the child touched the picture on the computer screen instead of the black button, the researcher reminded the child that each picture had its own black button and emphasized that she should punch the *black button* that went with the story. After the child indicated that she understood how to perform the memory task, the experimenter said, "Let's play the game again, but this time I want you to do it as fast as you can. As fast as you can, punch the black button that goes with the story." If a child simply pushed any button in order to choose quickly, then the experimenter emphasized that the child should look at both of the pictures and punch only the black button that went with the story he or she had read. As noted earlier, 21 children did not follow the instructions for completing the task and were omitted from the sample because a) they did not understand to push the buttons instead of the computer screen ($\underline{n} = 7$), b) they continued to look to the experimenter for approval before selecting a picture ($\underline{n} = 2$), or c) they showed a left or right side response bias ($\underline{n} = 12$) (i.e., they selected pictures on a single side for all of the practice trials).

After completing the pretest, Experimenter 1 read a story about two characters, John and Amy, that was accompanied by pictures displayed on a computer screen. Pretesting of the items showed that young children could identify the focal objects or activities in the pictures without hearing the accompanying story. The story consisted of

27 short episodes. The first three pictures were filler items to be included in practice trials during the final memory test presented at the second session. Each picture was displayed for 7 seconds while the experimenter read the accompanying text, which was not displayed on the screen. Presentation time for the story was approximately 5 minutes. Children received one of two story versions. A second story version was created by exchanging all of the original items in one story with the items that had served as either new or suggested items. Also, within each story version, the items that served as the control and misleading items were counterbalanced between subjects.

Following the story, children completed a puzzle for 4 minutes to attenuate recency effects. Experimenter 1 worked the puzzle with the child for 2 minutes until Experimenter 2 entered the room and joined them in completing the puzzle. Then, Experimenter 1 told Experimenter 2 that she and the child had been reading a story together. Making an excuse, Experimenter 1 left the room and suggested that the child continue working on the puzzle with Experimenter 2. After working the puzzle for 2 more minutes, Experimenter 2 said, "I'd really like to know more about the story that you and 'Experimenter 1' read together. May I ask you some questions about it?"

Experimenter 2 proceeded to ask 24 "yes-no" recognition questions about the story (see Appendix C). Twelve questions were asked in a straightforward manner. To guard against children answering the straightforward questions correctly as a result of a "yes" bias, 6 of the questions required a "yes" response, indicating that the item had occurred in the story, and 6 questions required a "no" response, indicating that the item

asked about had not occurred in the story. The other part of the interview consisted of 12 misleading tag questions that suggested to children information that conflicted with the details of the story. The misleading tag questions and straightforward questions were blocked. Half of the straightforward questions were asked before and half of the straightforward questions were asked after the presentation of the misleading tag questions. The list of items asked about in either a straightforward or misleading manner was counterbalanced between subjects. Items served equally often in the control and misleading conditions. Session one lasted approximately 25 minutes.

Session two. Children performed a computerized forced-choice recognition test and completed a set of theory of mind tasks 5 to 14 days after session one. The memory test was completed first, followed by the theory of mind tasks. Both experimenters attended the session and were seated one on each side of the child during the memory task. Practical concerns prevented a third experimenter from conducting the final test. Therfore, this procedure was used to control for the possibility that each experimenter may have been associated with a particular set of items and may have served as a retrieval cue for those items. Experimenter 1, who had presented the original story, instructed one-half of the children on the memory test. Experimenter 2, who had earlier interviewed and misled the participants, presented the memory test for the remaining children. The test began with six practice trials: three practice trials related to the Lion King story in which pictures from the Lion King were paired with new pictures from the story "Aladdin,"

which children had not seen, and three practice trials related to the filler items presented at the beginning of the target story about John and Amy.

After being seated in front of the computer, the child was instructed, "Do you remember the Lion King story you read last time? I'm going to show you some pictures and I want you to show me which pictures go with the Lion King story that you read. Look right here [pointed to screen] and pay close attention so that you can see the pictures. Here are two pictures. Each picture has its own black button, see? This picture has this black button and this picture has that black button (experimenter pointed to each picture and its corresponding button). As fast as you can, punch the black button that goes with the story that you read last time." Following the Lion King trials, the Experimenter said, "Now, do you remember the story that you read about John and Amy? I'm going to show you some more pictures. I want you to show me which picture goes with the story that you read about John and Amy. As fast as you can, punch the black button that goes with the story about John and Amy."

Presentation of the test items immediately followed the practice trials and continued until the last target trial was presented. When children pressed a button to make their selection, the pictures immediately disappeared and the next trial was presented. The presentation of trials was separated by a delay of 5 seconds for both the practice and target trials in order to allow time for the experimenter to repeat the instruction, "As fast as you can, punch the black button that goes with the story," between trials. The 24 target trials consisted of 12 Control trials in which the original story item

was paired with a new item, and 12 misleading trials--six trials in which the original story item was paired with the suggested item (Original Condition) and six trials in which the original story item was paired with a new item, instead of a suggested item (Modified Condition). Thus, the memory test consisted of 30 pairs of pictures, 24 of which were pairs relating to target story items. The 24 target pairs were presented in four different random orders.

Following the memory test, children completed a series of theory-of-mind tasks assessing their understanding of: a) general mind-world connections (GMW) (Pillow, 1989; Ruffman & Olson, 1989; Taylor, 1988a); b) specific mind-world connections (SMW) (O'Neill & Gopnik, 1992); c) conflicting mental representations (CMR), including false belief (e.g., Wimmer & Perner, 1983), appearance-reality (Flavell et al., 1986), and representational change tasks (Astington & Gopnik, 1988; Gopnik & Slaughter, 1991); and d) memory representation (MemRep)(Custer, 1996) (see Appendix D). The theory of mind tasks assessing each type of understanding were blocked and presented in three random orders. Session two lasted approximately 25 minutes.

RESULTS

Descriptive Statistics and Preliminary Analyses

Table 1 shows descriptive statistics for children's theory of mind performance and their memory performance under misleading and control conditions. Results for memory performance are reported in terms of proportions because the data consisted of unequal numbers of observations. At least one trial was omitted for 15 of the 57 participants because of children's inattention or failure to follow the instructions on a particular trial. All children for whom trials were omitted had a minimum of 4 out of 6 observations possible for the Original Test and the Modified Test (8 out of 12 total observations for the misleading conditions) and a minimum of 9 out of 12 possible observations for the Control Test.

Results for total theory of mind scores are also reported in terms of proportions because at least one task was omitted for 13 children who did not answer control questions correctly. Two tasks were omitted for two of these children. Four children failed the control task for one of the General Mind-World connections tasks adapted from Taylor (1988), and thus claimed that Bert would not be able to identify the animals even when Bert was allowed to see the entire picture. Ten children failed to state in the representational change task that Bert knew the real contents of a container immediately after he looked inside. In response to the appearance-reality question, "What color does

this fish look like to your eyes right now, green or white (white or green)?" two children stated that the white fish looked green when it was first presented, prior to the green filter being placed over it.

Table 1. Descriptive Statistics for Memory and Theory of Mind Performance

	M	SD	Range
Original Test	.71	.22	.20-1.00
Modified Test	.75	.23	.33-1.00
Total Misleading Correct (Original and Modified)	.73	.18	.27-1.00
Control Test	.69	.19	.18-1.00
Total Theory of Mind	.54	.28	.00-1.00
General Knowledge Connection	.55	.31	.00-1.00
Specific Knowledge Connection	.57	.43	.00-1.00
Conflicting Mental Representation	.53	.30	.00-1.00
Memory Representation	.66	.27	.00-1.00

Note. Results are reported in terms of the proportion of items correct.

To determine whether there were misinformation effects, three planned mean comparisons (dependent t-tests) were performed on the proportion of items correct between the Control Test and Original Test, the Control Test and the Modified Test, and the Control Test and Total Misleading Correct (collapsed across both Original and Modified Tests). Contrary to expectation, the results did not reveal a misinformation effect. Children tended to be more accurate in the Modified Test relating to episodes about which they were misled than they were in the Control condition, although the difference between the means was small, $t(56) = 1.95$, $p < .056$. Differences in performance between the Control Test and the Original Test, $t(56) = .55$, $p < .58$, and between the Control Test and Total Misleading Correct, $t(56) = 1.57$, $p < .12$, were nonsignificant.

A 2 (Experimenter: Story Presenter versus Interviewer) x 3 (Test: Control, Original, Modified) analysis of variance (ANOVA) with repeated measures on the last factor was performed to examine the occurrence of misinformation effects as a function of which experimenter presented the instructions for the final test. The dependent variables were the proportion of items correct in the Original, Modified, and Control Test conditions. Both the main effect of tester, $F(1, 55) = .79$, $p < .37$, and the interaction between tester and memory test condition, $F(2, 110) = 1.50$, $p < .22$ (Greenhouse-Geisser p-value correction), were nonsignificant.

To determine whether misinformation effects differed as a function of age, a median split was used to divide children into younger and older age groups ($M = 45.85$

months, range = 38 to 53 months; and $\underline{M}$ = 58.06 months, range = 54 to 65 months, respectively). Three sets of analyses were performed: a 2 (Age) x 2 (Test: Original versus Control) ANOVA, a 2 (Age) x 2 (Test: Modified versus Control) ANOVA, and a 2 (Age) x 2 (Test: Total Misleading versus Control) ANOVA with repeated measures on the last factors. The dependent variable was the proportion of items correct in each test condition. All three Age x Test effects were nonsignificant, $\underline{ps} > .10$ Thus, neither age group showed a misinformation effect, nor did younger and older children differ in their memory performance on misleading versus control tests.

A 2(Story Version) x 2 (Item) x 2(Test: Control versus Total Misleading Correct) ANOVA with repeated measures on the last factor was performed to determine if memory performance differed as a function of which story version was presented and which items served as the control and misleading items for each story. The dependent variables were the proportion of items correct in the Control Test and the combined Original and Modified Tests conditions (Total Misleading Correct). Results revealed a significant Item x Test interaction, $\underline{F}(1, 106) = 4.48$, $\underline{p} < .01$, and a significant Story x Item x Test interaction, $\underline{F}(2, 106) = 3.73$, $\underline{p} < .03$ (Greenhouse-Geisser p-value corrections). To further examine the Item x Test interaction, mean comparisons (dependent t-tests) were performed between the Control Test and Total Misleading Correct condition as a function of Item. Results showed that, for one set of items, children showed better memory for items in the misleading tests ($\underline{M} = .77$) than for items in the control condition ($\underline{M} = .66$), $\underline{t}(27) = 3.02$, $\underline{p} < .005$. However, this difference was not significant for the second item

list in which the items serving as the misleading and control items were reversed, (*M*s = .72 and .70, respectively), $t(28) = .64$, $p < .52$.

Mean comparisons (dependent t-tests) between the Control Test and Total Misleading Correct performed as a function of Story Version and Item showed that item effects were limited to one version of the story. Children showed better memory for items in the misleading tests (*M* = .81) than for items in the Control Test (*M* = .67), $t(14) = 3.21$, $p < .006$, for one of the four Story x Item combinations Performance between the misleading items and control items did not differ for the three remaining Story x Item conditions. Because there were no pervasive item effects, data across all conditions were combined for the purpose of examining the relation between suggestibility and theory of mind performance.

Theory of Mind Performance and Suggestibility

Three sets of analyses were performed to examine the relation between theory of mind performance and suggestibility. The first analysis was performed to determine the occurrence of misinformation effects as a function of children's theory of mind performance. Although misinformation effects were not obtained for the entire sample, suggestibility may differ as a function of children's level of representational understanding. An assumption of the model is that the greatest attenuation in misinformation effects should be realized when children's theory of mind performance across all tasks is high rather than low. As expected, the theory of mind scores were intercorrelated. Semipartial correlations between the theory of mind tasks, controlling for age, were CMR/GMW,

$r(55) = .30$, $p < .05$; CMR/SMW, $r(55) = .33$, $p < .05$; and GMW/SMW, $r(55) = .40$, $p <$ 01. Therefore, participants were separated into two groups based on their total combined scores on theory of mind tasks, excluding scores for the memory representation task.[1] Children who answered at least 72% of the theory of mind tasks correctly (18 of 25 possible) were included in the high understanding group, resulting in 35 participants in the low category and 22 participants in the high category.[2]

A 2 (Theory of Mind Level: High versus Low) x 2 (Test: Control versus Total Misleading Correct) ANCOVA with repeated measures on the last factor was performed on the proportion of items correct in each test condition. Age was the covariate. The results showed a marginal main effect of Theory of Mind Level after controlling for age, $F(1, 54) = 3.46$, $p < .068$. The adjusted means showed that children with higher theory of mind scores showed better memory in both the control ($M = .77$) and misleading test conditions ($M = .77$) than did children with lower theory of mind scores ($Ms = .65$ and .71, respectively). Thus, children with greater representational understanding demonstrated better memory than children with lower theory of mind scores, regardless of whether or not they had been misled.

The standard procedure for measuring suggestibility in terms of misinformation effects is to compare the percentage of items children answer correctly when they are misled to the percentage of items children answer correctly in the control condition. This approach was used in the preceding analyses. However, this analysis of misinformation effects does not distinguish the relative contributions of children's memory ability when

they have not been misled and theory of mind performance to suggestibility effects. Therefore, a second set of analyses involving correlations and regressions were performed to clarify the relations among children's control memory performance, theory of mind performance, and degree of suggestibility. Suggestibility was defined as the proportion of items that children remembered incorrectly on the Original Test and the Modified Test. As in the above analyses, performance on the Control Test was measured as the proportion of items that children remembered correctly.

Table 2 shows correlations among theory of mind performance, memory performance in the Control, Original, and Modified Tests, and children's Total Suggestibility (collapsed across Original and Modified Tests). Each theory of mind variable, except for children's understanding of memory representations, was negatively related to suggestibility as measured in both the Original and Modified tests. Suggestibility decreased with an increase in representational understanding. Theory of mind performance was positively related to children's memory performance in the control test.

Age was negatively related to suggestibility in the Original Test, but was unrelated to suggestibility as measured in the Modified Test. Thus, when presented with the original item and the suggested item, older children were less likely to choose the suggested item than were younger children. Age was unrelated to performance in the control condition. Therefore, age-related changes in suggestibility as measured by the Original Test could not

Table 2. Correlations Among Age, Theory of Mind Performance, and Memory Performance

	Age	Total TOM	GMW	SMW	CMR	MemRep
Original Test	-.34**	-.36**	-.41***	-.44***	-.32*	-.07
Modified Test	-.08	-.30*	-.40**	-.30*	-.31*	-.02
Total Suggestibility	-.25	-.42***	-.47***	-.41***	-.37**	-.04
Control Test	.10	.38**	.35**	.34**	.37**	-.24

Note. * $p < .05$, ** $p < .01$, *** $p < .001$; TOM (Theory of Mind), GMW (General Mind-World Connection), SMW (Specific Mind-World Connection), CMR (Conflicting Mental Representation), MemRep (Memory Representation)

be accounted for by age differences in children's general ability to remember the story when they were not misled.

Three regression analyses were performed to determine if theory of mind performance predicted suggestibility independent of age and children's general ability to encode and remember the story details as assessed in the control condition. The predictor variables for the all three regression were entered in the following order: age, memory performance in the control condition, total theory of mind scores, and performance on the memory representation task. The dependent variable for each analysis was a suggestibility index based on the proportion of incorrect responses in the Original Test, the Modified

Test, and Total Suggestibility for both tests. As shown in Table 3, children's memory when they were not misled predicted Total Suggestibility, collapsing across the Original and Modified Tests. This effect was primarily attributable to the negative correlation showing that suggestibility on the Modified Test decreased with an increase in Control Test Performance. Theory of mind performance did not predict suggestibility in any of the three test conditions, after controlling for age and children's memory for the story when they were not misled.

Semipartial correlations were performed to determine the relation between the different types of representational understanding and suggestibility, independent of age and children's memory for the story in the Control Test condition. As shown in Table 4, the pattern of correlations between theory of mind variables and suggestibility remained significant after controlling for age, but was nonsignificant after controlling for both age and children's memory for the story when they were not misled.

The third set of analyses was performed to test the prediction that representational understanding plays a greater role in reducing suggestibility when children's control memory performance is low rather than high. A median split was used to divide participants into two groups based on their memory performance in the Control Test condition, resulting in 30 participants who showed poorer memory ($\underline{M}$ = .55, range = .18-.73) and 27 children who demonstrated better memory ($\underline{M}$ = .86, range = .75-1.00) for the story when they were not misled.

Table 3. Predictors of Suggestibility

Dependent Variable: Original Test				
	R^2	Beta	F	p-value
Model	.186		2.96	.028
Age		-.21		.182
Control Performance		-.20		.171
Theory of Mind		-.16		.327
Memory Representation		-.05		.703

Dependent Variable: Modified Test				
	R^2	Beta	F	p-value
Model	.348		6.94	.0001
Age		-.10		.472
Control Performance		-.55		.0001
Theory of Mind		-.14		.349
Memory Representation		-.17		.160

Table 3--continued

Dependent Variable: Total Suggestibility				
	R^2	Beta	F	p-value
Model	.334		6.51	.0001
Age		-.04		.740
Control Performance		-.45		.001
Theory of Mind		-.22		.147
Memory Representation		-.12		.317

Table 4. Semipartial Correlations Among Theory of Mind and Memory Performance

	After Removing Age			After Removing Age and Control Test Performance		
	GMW	SMW	CMR	GMW	SMW	CMR
Original Test	-.30*	-.33*	-.21	-.21	-.26	.12
Modified Test	-.41**	-.36*	-.30*	-.20	-.19	-.10
Total Suggestibility	-.40**	-.38*	-.30*	-.22	-.23	-.12

Note. * $p < .05$, ** $p < .01$. GMW (General Mind-World Connection), SMW (Specific Mind-World Connection), CMR (Conflicting Mental Representation).

Semipartial correlations were performed between total theory of mind scores and suggestibility as a function of Control Memory Performance Level, controlling for age. Table 5 shows that one of the three semipartial correlations between suggestibility and theory of mind performance was significant, and a second correlation was marginally significant, for children who had poor general memory for story details. However, none of the correlations were significant for children who showed good memory performance when they were not misled.

Table 5. Semipartial Correlations Between Theory of Mind Performance and Suggestibility as a Function of Level of Control Test Performance, After Removing Age

	Control Test Performance	
Suggestibility	Low	High
Total Suggestibility	-.42**	-.11
Original Test	-.24	-.08
Modified Test	-.30*	-.11

Note. * $p < .10$, ** $p < .05$

R-to-z transformations were performed to determine if the semipartial correlations between theory of mind performance and suggestibility differed as a function of children's Control Test performance. Independent t-tests performed on the z-scores showed that the semipartial correlations between theory of mind performance and Total Suggestibility scores differed as a function of children's memory for the original episodes when they were not misled, $t(55) = 1.96$, $p < .05$. Results for the Original and Modified Test condition both mirrored the findings for Total Suggestibility scores, although neither pair of correlations differed significantly as a function of control memory performance, $ps > .10$.

Examination of the obtained variability in theory of mind and Total Suggestibility scores as a function of Control Test Level indicates that the lack of a significant correlation between theory of mind scores and suggestibility for children with high levels of control performance was not attributable to restricted variability of scores in the High Control Performance group (theory of mind, range = .20 to 1.00, SD = .23; Total Suggestibility, range = 0 to .60, SD = .16) as compared to the Low Control Performance group (theory of mind, range = 0 to 1.00, SD = .29; Total Suggestibility, range = .08 to .73, SD = .15).

As reported earlier, the range of scores obtained for the control task was greater for children in the Low Control Performance group than for the High Performance Group. Further, correlations showed that theory of mind performance was positively related to control performance. These relations could have accounted for the finding that the correlation between theory of mind performance and suggestibility was stronger for children in the Low Control Performance group than for children in the High Control Performance Group. Therefore, a regression analysis was performed to determine if theory of mind performance remained a significant predictor of suggestibility for children who were less able to remember the details of the story, after controlling for variability in their control performance. Further analyses were not performed on the High Control Performance group because the results of the semipartial correlations showed a pattern of weak correlations between theory of mind performance and suggestibility for those children.

The predictor variables for the regression were entered in the following order: age, control performance, and theory of mind scores. Total Suggestibility was the dependent variable. The results, shown in Table 6, confirmed that theory of mind performance was a significant predictor of suggestibility, after controlling for age and children's memory for the original details when they were not misled.

Table 6. Predictors of Suggestibility for Children with Low Control Test Performance

Dependent Variable: Total Suggestibility				
	R^2	Beta	F	p-value
Model	.175		1.84	.164
Age		.24		.318
Control Performance		.04		.852
Theory of Mind		-.50		.048

To summarize the results regarding suggestibility effects, the memory reports of 3- to 5-year-olds in this study were as accurate when children had been misled as when they had not been misled. Neither younger nor older preschoolers showed misinformation effects. This finding was obtained for both the Original and Modified Tests.

Misinformation effects did not vary as a function of theory of mind performance. Theory of mind scores were negatively related to suggestibility, as assessed by the number of items children remembered incorrectly after being misled. However, performance on theory of mind tasks did not explain a significant amount of variance in suggestibility measures, after controlling for children's ability to remember the details of the original event. Semipartial correlations and regressions revealed that children's understanding of the representational mind was important for reducing suggestibility among those children who demonstrated less ability to remember the original details.

Reasoning About Conflicting Mental Representations and Response Time

Children who were able to reason about conflicting mental representations were expected to have longer latencies in the Original, Modified, and Total Suggestibility Tests than in the Control Test, whereas response times for children who were less able to reason about conflicting mental representations were not expected to differ across conditions. This pattern of results was anticipated because children who could reason about conflicting mental representations were hypothesized to require more time to process and evaluate their representations of both the misleading information and the original detail when they had been misled.

Preliminary analyses were performed to determine if children's response times differed as a function of age. Children were divided into younger and older age groups according to a median split. A 2 (Age) x 3 (Test: Control, Original, Modified) ANOVA was performed on children's mean response times. The results showed that the main

effect of age was nonsignificant, $F(1, 55) = .42$, $p < .52$, and the Age x Test interaction was nonsignificant, $F(2, 110) = 1.74$, $p < .18$ (Greenhouse-Geisser correction).

Participants were separated into two groups based on their performance on conflicting mental representation tasks (CMR). Children who answered at least 66% (6 of 9) of the CMR questions accurately were included in the high performance group ($n = 22$).[3] Thirty-five children were included in the low performance group. Three 2 (CMR performance: High vs Low) x 2 (Memory Condition) ANCOVAs with repeated measures on the last factor were performed on children's mean response times in the following conditions: Control versus Original Test, Control versus Modified Test; and Control versus Total Suggestibility. Age was the covariate. Reaction time was measured in seconds, to the thousandth of a second. Table 7 shows that, contrary to expectation, none of the analyses revealed significant differences in response times between misleading and control tests as a function of CMR performance, nor did response times differ between misleading and control tests, after collapsing across CMR level, (all $ps > .10$).

A 2(CMR Level) x 2 (Test: Control Test versus Total Suggestibility) x 2 (Memory Performance: Accurate versus Inaccurate) ANCOVA with repeated measures on the last two factors was performed to determine if children with an understanding of conflicting mental representations were slower than children lacking this understanding when choosing inaccurate information in the misleading condition. Children's response times in the control condition were not expected to differ as a function of representational understanding.

Missing cells were obtained because 8 children responded accurately for every target item in the misleading tests and/or the control test. Therefore, the analyses were conducted on the data for the 49 children who responded inaccurately on at least one target item in each of the tests. The omission of these participants resulted in 19 children in the High CMR group and 30 children in the Low CMR group. The dependent variable was children's mean response times. Age was the covariate. The results showed a marginally significant main effect of CMR Level on children's response times, $F(1, 46) = 3.06$, $p < .087$. Table 8 shows the adjusted means. Children with higher CMR scores responded more slowly than children with lower CMR scores in both the misleading and control conditions, regardless of whether they were accurate or inaccurate.

Although the omnibus test did not reveal a CMR Level x Test x Accuracy interaction, two 2 (CMR Level) x 2 (Test) ANCOVAs with repeated measures on the last factor were performed separately for children's inaccurate responses and accurate responses to examine the hypothesized interaction. Age was the covariate. The results for children's inaccurate responses showed a marginally significant main effect for CMR Level, $F(1, 46) = 3.77$, $p < .059$. Children with high CMR scores had slower response times than children with low CMR scores for both the misleading and control conditions. The children in the high CMR performance group were significantly older than children in the low performance group (Ms in months = 55.63, 49.93; ranges = 38-61, 41-65, respectively), $t(47) = 2.87$, $p < .006$. Thus, these findings are the opposite of the results that would be expected as a function of age. Response times did not differ as a function

of test condition, $F(1, 46) = .09$, $p < .75$. The CMR Level x Test interaction was nonsignificant, $F(1, 46) = .36$, $p < .55$. The analyses for children's accurate responses times showed no significant effects. Response times did not differ as a function of CMR Level, $F(1, 46) = 1.41$, $p < .24$, or test condition, $F(1, 46) = .73$, $p > .39$. The CMR x Test interaction was nonsignificant, $F(1, 46) = .20$, $p < .65$.

Table 7. Mean Response Times as a Function of Children's Level of Conflicting Mental Representation Understanding and Memory Test, After Adjusting for Age.

	Memory Test			
CMR Level	Control	Original	Modified	Total Suggestibility
Low				
M	3.87	3.89	3.93	3.91
SD	.18	.17	.17	.16
High				
M	4.11	4.10	4.03	4.07
SD	.24	.24	.22	.20

Note. Response times are reported in seconds.

Table 8. Mean Response Times as a Function of Children's Understanding of Conflicting Mental Representations, and Memory Performance, After Adjusting for Age

	Conflicting Mental Representation Level					
	Low			High		
Memory Performance	Control	Misleading	M	Control	Misleading	M
Accurate						
M	3.64	3.79	3.71	4.00	4.05	4.02
SD	.16	.18	.17	.20	.23	.22
Inaccurate						
M	3.49	3.27	3.38	4.27	3.77	4.02
SD	.28	.19	.24	.36	.24	.30

The two 2 (CMR Level) x 2 (Test) ANCOVAs reported above were performed separately for the Original and Modified Tests. Missing cells were obtained because 24 children responded accurately for every target item in at least one of the two misleading tests and/or the control test. Therefore, the analyses were conducted on data for the 33

children who responded inaccurately on at least one target item in each of the tests. The results for both the Original and Modified Tests mirrored the findings reported earlier for the two tests combined. The results for children's inaccurate responses in the Original Test showed a significant main effect for CMR Level, $\underline{F}(1, 30) = 4.68$, $\underline{p} < .04$. The results for children's inaccurate responses in the Modified Test showed a marginally significant main effect for CMR Level, $\underline{F}(1, 30) = 3.52$, $\underline{p} < .07$. For both analyses, children with high CMR scores had slower response times than children with low CMR scores when choosing incorrectly in both the misleading and control conditions. Analyses involving children's accurate responses did not differ as function of CMR Level for either the Original Test or Modified Test, $ps > .10$.

To summarize, the results for response times showed partial support for the relations specified in the active mind model. First, children showed equivalent response times across all three test conditions regardless of their level of conflicting mental representation understanding. Thus, contrary to expectation, children with higher conflicting mental representation scores did not respond more slowly when they were misled than when they were not misled. Children who were able to reason about conflicting mental representations also did not respond more slowly in the misleading test than children without this understanding. Together, these results indicated that children who were better able to reason about conflicting mental representations were not considering multiple representations of the original and suggested information at the time of the test. However, these results were qualified by an examination of children's

response times as a function of their accuracy. Children who were better able to reason about conflicting mental representations responded more slowly than children without this understanding, particularly when they made incorrect responses. Children with an understanding of conflicting mental representations made incorrect responses more slowly than children with low understanding for both the misleading and the control tests. The direction of these findings was the same for both the Original and Modified Tests.

Notes

1. Recall that Custer (1996) found that children were able to reason about conflicting representations in the context of remembering earlier than they were able to understand conflicting representations in the context of belief. Therefore, all analyses of variance examining children's memory and reaction-time performance as a function of their ability to reason about conflicting mental representations were repeated using children's level of performance on the memory representation task adapted from Custer (1996) as a grouping variable. The results of these analyses showed that memory performance and response times clearly did not differ as a function of children's level of performance on the memory representation task. Further, correlations showed that this task was unrelated to the other theory of mind tasks (see Table 2).

These results were not surprising because many children clearly did not understand the instructions for completing the task. Children were to select which one of two "thought bubbles" represented a story character's mental state of remembering. In previous studies, young children apparently understood and followed directions for similar procedures involving the use of "thought bubbles" (e.g., Custer, 1996; Miller, Kessel, & Flavell, 1970; Schult, Hollander, & Wellman, 1994; Welch-Ross, 1995); however, in the present study, many children refused to select a picture, selected both pictures, or pointed to the arrows leading to the thought pictures rather than the pictures themselves for some trials.

2. Several studies in the theory of mind literature have included a categorical variable of theory-of-mind performance based on whether children answered correctly or incorrectly on a specified number of theory of mind tasks (e.g., Jenkins & Astington, 1996; Melot, Houde, Courtel, & Soenen, 1995; Robinson & Mitchell, 1995). However, a standard criterion is not established for distinguishing between high and low theory of mind performance, and therefore, the criteria used for forming these categories vary across studies. In the present research, the criterion of 69% correct indicated the minimum

number of tasks children needed to answer correctly in order to be correct more often than would be expected by chance ($z = 1.98$, $p < .05$).

3. Children needed to reach the criterion of 88% (8 out of 9 questions) on conflicting mental representation tasks in order to be correct more often than would be expected by chance with $p < .05$. However, only 13 of the 57 children in this sample reached this level of performance; therefore a criterion was set at the highest possible level (i.e., 66%) that provided a number of subjects in the High CMR Level category that was reasonable for conducting analyses.

DISCUSSION

Overview

The discussion focuses first on children's memory performance and the ways in which the present results extend previous research on suggestibility in preschoolers. Then, the findings are reconciled with the predicted pattern of relations involving suggestibility, response time, and theory of mind performance. Limitations of the present procedure are discussed and future research is proposed for testing further the predictions derived from the active mind model of children's suggestibility.

Memory Performance and Suggestibility Effects

Misinformation effects have typically been found for the Original Test, but not the Modified Test, in the majority of previous studies of suggestibility in children (for reviews see Loftus et al., 1992; Toglia et al., 1992; Zaragoza et al., 1992). However, the results of this research concur with the findings of one other study in which no misinformation effects were obtained for either the Original or Modified Test (see Zaragoza et al., 1992). Many researchers agree that preschoolers, and 3- and 4-year-olds in particular, are more suggestible than older children. This consensus is based on findings obtained with the standard method for measuring misinformation effects and a variety of other procedures for assessing suggestibility. Why were there no misinformation effects for either the younger or older preschoolers in this study?

One aspect of the procedure would have been expected to promote suggestibility. Research shows that children are more suggestible when they are presented with information that contradicts a witnessed detail (e.g., the interviewer suggests to children that a person touched them on the leg when actually the person touched them on the arm) than why they are exposed to information that inserts a detail, indicating that a particular episode occurred when actually it did not (e.g., the interviewer suggests to children that a person touched them when in fact the person did not touch them at all) (Pezdek & Roe, 1994, 1995). In the present research, children were presented with suggested items that contradicted rather than inserted a witnessed detail which is known to increase suggestibility.

However, several other aspects of the procedure may have attenuated misinformation effects. For example, children and adults are less suggestible when misleading information is presented immediately following the original event rather than following a long delay. Moreover, suggestibility is reduced when a long delay occurs between the presentation of suggested information and the final test, rather than when suggested information immediately precedes the final test (for further discussion of delay effects see Schooler & Loftus, 1993, and Zaragoza et al., 1992). The combination of a short delay between the story presentation and the misleading interview and a relatively long delay between the misleading interview and the final test may have minimized suggestibility in this study.

Further, conflicting information perceived via the same sensory modality is more easily confused than conflicting information perceived via different sensory modalities (see Pezdek & Roe, 1994). Misinformation effects are attenuated when the final test is presented in the same modality as the witnessed event, but in a different modality from the presentation of suggested information. For example, seeing the original detail, hearing the suggested item during an interview, and performing a picture recognition task for the final test results in less suggestibility than seeing the original detail, hearing the suggested item during an interview, and answering questions during an interview for the final test. The present study included the former procedure associated with diminished misinformation effects.

Another possibility for the lack of a misinformation effect is that preschoolers perform very well on recognition tests that assess memory for visual stimuli (Brown & Campione, 1972; Brown & Scott, 1971; Perlmutter & Meyers, 1974). Therefore, they may be less suggestible in a picture recognition test than during a second interview in which, for example, children report their memories by responding to a series of "yes-no" questions. However, this explanation seems unlikely for several reasons. First, mean control performance in the present study was 70%, which is not significantly greater than chance level (test of the significance of a proportion, $p > .05$). Thus, the picture recognition task was not exceptionally easy for preschoolers. Second, children have shown better memory for items about which they were not misled in other studies using interviews consisting of "yes-no" questions (e.g., 86% in the Welch-Ross et al., in press,

study, which was significantly greater than chance). Finally, other studies of misinformation effects using picture-recognition tests with far fewer target items still show misinformation effects (at least with the Original Test) for both preschoolers and adults.

An alternative explanation is that the within-subjects design used in the present study could have constrained control performance relative to the higher levels of control performance typically obtained in between-subjects designs (for further discussion see Marche & Howe, 1995; Toglia et al., 1992; Zaragoza et al., 1992;). This reduction in control performance may occur because children begin to doubt the validity of their own memories in the face of the perceived authority of an interviewer, who has presented them with details that conflict with their experiences. Also, children's memory for details about which they were not misled may be weakened because they become confused about their memory of the entire event following exposure to suggested information about some of the episodes (Howe, 1991; Marche & Howe, 1995). Regardless of the particular mechanism involved, poor control performance may preclude the detection of differences in memory that occur as a function of whether or not children were misled. Researchers have invoked this "dampened" control performance explanation previously in order to explain the inconsistent appearance of misinformation effects across studies.

Mean control performance was not significantly greater than the level that would be expected if children were guessing. Therefore, the findings are consistent with the notion that within-subjects designs "dampen" control performance and minimize the opportunity to detect misinformation effects. Yet, the overall level of memory

performance was quite good, with children remembering 70%, 71%, and 75% of the original information accurately in the Control, Original, and Modified tests, respectively. This level of control performance is consistent with other research with preschool samples (Toglia et al., 1992; Zaragoza et al., 1992). However, in most of the previous research, children were presented with much shorter scenarios and asked to remember many fewer episodes in comparison to the present study (for an exception, see March & Howe, 1995). Therefore, the level of performance obtained here was particularly impressive considering the number of target items children were asked to remember.

At least one study indicates that this explanation for the absence of misinformation effects may be unlikely (Welch-Ross et al., in press). In this research, an interviewer asked children both nonleading and misleading questions about the details of a story. The interview consisted of two sets of nonleading questions separated by an intervening set of misleading questions. The results showed that children were as accurate after they were asked misleading questions as they were before they were misled.

Certainly, the within-subjects design is the more powerful design, and one could argue, the most ecologically valid design in that it involves suggesting inaccurate information to witnesses about some of the details, but not misleading them about others. An important consideration is that the critical comparison for detecting misinformation effects concerns children's relative performance between the control and the misleading tests, independent of whether or not control performance is lower because those same children were misled. If the presentation of suggested information leads to a

misinformation effect, then conceivably performance on the misleading tests could fall to levels even lower than would be expected by chance. Thus, the opportunity to detect misinformation effects should not be seriously constrained unless control performance reaches a very low level.

Another possible explanation for the lack of misinformation effects is that many of the items used in the present study were easier for children to remember than the items used in previous studies, thereby contributing to children's resistance to misinformation. Studies with adults and children indicate that misinformation effects are sometimes found for some items but not for others (Toglia et al., 1992; Tousignant et al., 1986). The items used in the present research were based on items used in earlier studies, and therefore it is unclear why they might have minimized suggestibility. Pretesting of the stimuli ensured that young children could identify the focal objects or activities in the pictures without hearing the accompanying story. However, the results clearly showed that some items were easier for children to remember than others. For one particular story x item combination, children's memory was even better after they had been misled than when they had not been misled. In addition, their memory for items about which they had been misled was above chance for this particular set of items.

In sum, any one of the variables discussed above could have operated either in isolation or in combination with the others to diminish misinformation effects. Whether children are deemed to have been suggestible in this research depends on one's perspective. A positive interpretation of the findings is that children, including younger

and older preschoolers, were not inevitably misled by the presentation of suggested information given that a) they were as accurate when they were misled as when they were not misled and b) their mean accuracy was close to 75%. A more negative interpretation is that children were inaccurate for more than 25% of their responses. This degree of error could be a critical one in the real world; however, based on the findings of this study, it is unclear whether this degree of error would differ from that of adults.

This research examined whether children's memory for items about which they were not misled predicted their suggestibility. In the literature on suggestibility, misinformation effects are defined as the difference in memory between misleading and control conditions. This approach implies that, when misinformation effects are not found, any incorrect responses for items about which a person has been misled are a function of the inability to remember the original details of the event, as measured by the control test. However, tests of misinformation effects do not examine this assumption directly.

The results of the present research showed that children's memory for the details of the witnessed event when they were not misled was a strong predictor of their memory for details following exposure to suggested information, but only in the Modified Test. This finding remained significant after controlling for age. Hence, children's general ability to encode and retrieve their memories of previously experienced events appeared to reduce their suggestibility when asked to chose between the original item and a completely new one.

This study did not directly assess whether or not children remembered the specific original episodes about which they were misled, even when they chose the incorrect item on the test. However, the findings strongly indicate that children who are less able to remember the original detail are likely to be misled about that episode. Further, control memory performance did not predict performance on the Original Test, in which children chose between the original detail and the suggested item. This finding implies that children who were better able to remember the original episodes chose the suggested items as often as children who were less able to remember the original information. This finding is consistent with speculation and research indicating that poor performance on the Original Test occurs not because of an inability to remember the original details, but because the presence of the suggested item on the test strongly encourages individuals to accept it (Loftus & Hoffman, 1989; Loftus et al., 1992; McCloskey & Zaragoza, 1985; Zaragoza et al., 1992).

Theory of Mind and Suggestibility

A portion of the findings showed that the occurrence of misinformation effects did not vary as a function of children's level of theory of mind performance. Regressions and correlations showed that this lack of relation between theory of mind performance and misinformation effects was a function of a) a significant negative relation between suggestibility and children's memory for the story when they were not misled and b) a significant positive correlation between theory of mind performance and children's memory performance on the control test. Semipartial correlations confirmed that the

negative relations that were obtained between performance on theory of mind tasks and suggestibility remained significant after controlling for age, but were nonsignificant after controlling for children's memory performance in the control test.

Given the correlation between children's theory of mind performance and children's memory for details when they were not misled, one might speculate that theory of mind tasks are simply measures of memory ability. Therefore, it may not be surprising that theory of mind performance was not a significant predictor of reduced suggestibility after controlling for memory performance in the control test. Although successful performance on theory of mind tasks undoubtedly involves a short-term memory component, researchers of children's developing theory of mind have clearly demonstrated that these tasks tap into the development of a real social cognitive skill that is not a mere epiphenomenon of increased memory performance or information processing capacity that develops with age (Flavell, 1986; Flavell et al., 1986, 1987; Gopnik & Astington, 1988; Gopnik & Slaughter, 1991; Jenkins & Astington, 1996; Perner, 1991, Chapter 8). For example, young preschoolers who fail appearance-reality tasks can remember the color of the object before the filter is placed over it (and can predict the color that the object will be when the cover is removed) (see Flavell, 1986; Flavell et al., 1986, 1987). Further, young preschoolers' performance on control tasks included in studies on children's understanding of representational change indicates that children adequately remember changes in external situations in procedures that parallel the procedure used in the representational change task (Gopnik & Astington, 1988; Gopnik & Slaughter, 1991).

For example, in one control task, children were shown a box with an apple inside. Then the apple was taken out of the box and a toy truck was placed inside. Children correctly stated that a truck was presently inside the box, but that an apple was previously inside the box. Consider also that, in the test of children's understanding of specific mind-world connections, children have no difficulty remembering the contents of a container, which they learned about through either looking inside the container or being told what was inside. Yet, these children are unable to determine how they know the remembered contents.

The relation between theory of mind performance and memory in the control test need not be interpreted as showing that successful performance on theory of mind tests is a function of memory ability. Alternatively, theory of mind skills may also contribute to children's ability to remember the original details when they are not misled, thereby indirectly leading to reductions in suggestibility. Indeed, recent models of the development of personal event memory have focused on the importance of children's understanding of the representational mind to the development of episodic recall (Nelson, 1993; Perner, 1991; Welch-Ross, 1995b, 1996b). Some researchers have proposed that the ability to recognize connections between information access and knowledge is critical for establishing mature episodic traces in which children encode information necessary for explicitly recognizing that they experienced a particular event (Perner, 1991; Welch-Ross, 1995b). Consistent with these hypotheses, preschoolers in one study who were able to understand specific mind-world connections performed better on recognition and recall

measures of memory for categorized lists of words than children who were unable to connect their knowledge to specific experiential origins (Perner & Ruffman, 1995). The procedure included tasks described earlier in which children predicted what a person would have to do to obtain a specific kind of knowledge (e.g., see or feel an object to know its texture or color) as well as measures in which children explained how they knew a piece of information after seeing it or being told about it.

In other research, the relation between 3- to 5-year-olds' personal event memory and performance on theory of mind tasks was examined (Welch-Ross, 1996b). Event recall was measured in terms of the amount of new information children provided in conversations with their mothers about past experiences, for example a family vacation. Children completed the theory of mind tasks that were included in the present study. The results showed that children who were better able to understand the connection between information access and knowledge, who were able to connect their knowledge to specific experiential origins, and who were able to reason about conflicting mental representations provided more information in response to their mothers' questions than children who performed less well on these theory of mind tasks. The findings were independent of age and a measure of verbal skill. Thus, conceptual models and research on the development of children's event memory indicate that a portion of the variability in suggestibility associated with children's recall when they were not misled could be indirectly mediated by representational skills that foster the development of children's event memory.

However, the present data support another explanation for the nonsignificant relations between theory of mind performance and suggestibility after removing control memory performance. Theory of mind skills may interact with memory for the original event to reduce suggestibility, particularly when children must distinguish their memories of the original details and suggested information. That is, when children demonstrated better memory for the original event, they were able to resist suggested information and theory of mind skills were not necessary for boosting children's resistance any more than their memory for the original items could do alone. However, theory of mind skills played a more critical role in reducing suggestibility among those children who were less able to remember the original details. This finding can be explained within the relations specified in the active-mind model. Figure 2 depicts a description of on-line processing that is consistent with the present data.

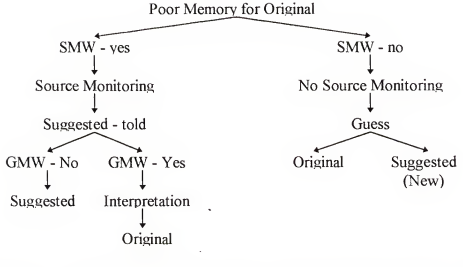

Figure 2 - Active Mind Model of Mental Processing When Event Memory Is Poor

Note. CMR (Conflicting Mental Representation), SMW (Specific Mind-World Connection), GMW (General Mind-World Connection).

When a child remembers the suggested information, but cannot remember the original event, she must determine the source and evaluate the validity of the suggested information. She may begin this process by determining the origin of her strongest or only memory. If the child cannot reason about specific mind-world connections she will be unable to determine that the source of her memory is the suggested information. However, if she can reason about specific mind-world connections, she has the metacognitive skill necessary for determining that the source of her strongest (only) memory is the information that the interviewer told her.

At this point she must evaluate the validity of the information that she recognizes as originating with the interviewer. If the child understands the general relation between experiencing an event and knowing about it, she can determine based on the interviewer's lack of information access that the information obtained from the interviewer is no more valid than the original item on the test for which she has a weaker memory (or no memory at all). She now has grounds for eliminating the information that the interviewer told her and for choosing the original item on the Original and Modified Tests. However, if she does not understand the connection between experiencing and knowing, she may believe that the item that the interviewer suggested is a better choice than the item for which she has only a weak memory or no memory at all (at least in the absence of any other discrediting information about the interviewer). In this case, she must guess between the original item and the new item on the Modified Test, although she may choose the original

item based on her weak memory of it. The child would systematically choose the suggested item on the Original Test. In essence, children receiving the Original Test may be following the rule, "If I can determine that the strongest memory I have for a particular episode originated with the interviewer, then in order not to choose that information, I need a reason to reject it as false." Children who possess a more advanced level of representational understanding, and are faced with the option of choosing the suggested information on the Original test, have a reason for rejecting the suggested item. Perhaps more importantly, children without representational skills may lack a reason for not consistently choosing the suggested information.

The above description of mental processing seems to imply a minimal role for the emerging ability to understand conflicting mental representations. Children cannot consider two representations of the event if they do not remember the original detail. However, the findings should not be interpreted as indicating that children in the low control memory performance category retained absolutely no memory for the original items. Previous investigations of suggestibility have been limited in their assumption that memory is an all or none process in which a person either clearly does or does not recall the original event following exposure to suggested information (see Brainerd & Reyna, 1988, and Ceci, Togia, & Ross, 1988, for related discussions). The present data indicate that children who have very good memory for the original event may select the original detail based on the strength of the memory trace. However, in order for children with relatively poor memory to select their weaker memory of the original detail, they must use

their representational skills to evaluate the validity of the information that the interviewer suggested to them, while simultaneously considering their weaker memory as a possible representation of the way the original event occurred.

Clearly, the information processing pathways discussed thus far do not allow for a distinction between children who are less able to remember the original episodes and children who are unable to consider their original memory representation as a plausible answer to reporting the way the world actually is after exposure to contradictory information. The same outcome would obtain regardless of which problem children experienced, either mnemonic or representational. A direct test is needed to determine whether children actually considerer multiple representations of the event at the time of the test.

Examining children's response times is one way to distinguish effects of memory from effects of representational understanding and to determine if children are indeed considering multiple representations of the event. Children who are able to reason about conflicting mental representations would be expected to have slower response times in the misleading test than children who are less able to reason about conflicting mental representations. Also, children who are able to consider conflicting mental representations would be expected to take longer to respond to items about which they have been misled than to items in the control condition, whereas children who are less able to consider conflicting mental representations should have equivalent response times in both the misleading and control tests.

The results provided partial support for this hypothesis. The response times of children who were better able to reason about multiple representations were longer than children who had lower scores on conflicting mental representation tasks; however, contrary to expectation, their response times were longer in the both the misleading and control conditions. Trials for the control test and misleading tests were presented to children in a random order. Thus, one explanation for this finding is that children who were able to reason about conflicting mental representations experienced a "spreading effect" that influenced their speed of performance on the control items. This interpretation does not necessarily mean that these children were consciously aware of a need to perform the task more slowly because they knew that they needed to consider their multiple representations of events for an unknown portion of the items. Rather, these children may implicitly have taken a different approach to the task and considered each trial more thoughtfully after experiencing the need to consider their multiple representations of the event for the items about which they were misled.

Additional research is needed to investigate this explanation for the present findings. In future studies, children's memory and reaction times might be assessed in a separate recognition test concerning an event that is unrelated to the target event. Children who understand conflicting mental representations would be expected to show faster response times on the unrelated tasks in comparison to a task in which they must respond to both misleading and control items. Perhaps a better procedure for addressing this issue may be to present the control and misleading test items in blocked trials, instead

of randomized trials. A set of control items would be presented first to obtain a baseline measure of response time, followed by a set of trials assessing memory for items about which children have been misled, and concluding with a second set of control items. Based on the results of the present study, children who understand conflicting mental representations would be expected to have slower response times for items on the misleading test and in the second set of control tests in comparison to their responses on the first set of control items. Children without the ability to reason about conflicting mental representations would be expected to show equivalent response times across the three conditions.

Results showing that children's response times did not differ as a function of their understanding of conflicting mental representations were qualified by whether or not children made accurate or inaccurate responses on the recognition test. The finding that children who were better able to reason about conflicting multiple representations were slower than children without such understanding when making incorrect choices requires further investigation. Research is needed to determine if children who are able to reason about conflicting mental representations begin to spend time on discrepancy detection only when they experience uncertainty. Further, future work may show that additional processing time may benefit children with source monitoring capabilities, whereas children without source monitoring skills still would have to guess, as shown in Figure 1.

These results for children's response times are consistent with the proposal of Loftus et al. (1989) that the speed with which a person chooses inaccurately on

recognition tests after having been misled provides an assessment of how strongly the person believes in the inaccurate memory of the event. In the present study, among children who were inaccurate in the misleading test conditions, those children who were less able to reason about conflicting mental representations made their incorrect choices more quickly than children who demonstrated a greater understanding of conflicting mental representations. This finding indicates that these children may have considered only the incorrect representation they accepted from the interviewer and thus required less time to make their inaccurate response.

Importantly, this pattern of results is the opposite of the findings that would be expected as a function of age-related changes in mental processing speed. Response times decrease with age on a variety of cognitive tasks, including visual discrimination, visual search, selective attention, and number comparison (i.e., determining which of two numbers is larger). If both younger and older children are responding based on identical representations of the event, older children would be expected to make their choices more quickly than younger children. The children who had higher scores on conflicting mental representation tasks were significantly older than children who had lower conflicting mental representation scores. Yet, these children responded more slowly than children who were less able to reason about conflicting mental representations. Furthermore, there were no age differences in response times for all three test conditions. Therefore, the finding that children with lower conflicting mental representation scores (who on average were younger) responded more quickly is not attributable to the possibility that younger

children were more impulsive than older children or were failing to perform the task as carefully as older children.

Interpreting the meaning of children's response times is difficult, particularly when using reaction-time measures as an index of higher level cognitive processing. In research with adults, response times during memory scanning tasks have been partitioned into three information processing stages: stimulus-encoding, memory-comparison, and response selection (e.g., Salthouse & Somberg, 1982). Similar studies have not been performed with young children; however, based on other developmental studies of processing speed (Cerella & Hale, 1994; Hale, 1990; Kail, 1991; Kail & Park, 1992), the expectation would be that older children would respond more quickly than younger children in each of the phases. Future research must include a separate visual discrimination task that requires stimulus-encoding and response-selection, but does not require memory comparison, in order to specify the amount of variability in reaction times that is associated with the evaluation of memory representations.

A visual discrimination task was not included in this research because the primary hypotheses involved within-subjects effects. Children who were able to reason about multiple representations were expected to respond more slowly when misled than in the control condition, whereas this comparison for children who were less able to reason about conflicting mental representations was expected to be nonsignificant. However, between-group differences were obtained because children who were able to reason about conflicting mental representations responded more slowly whether or not they were

misled. Any interpretation of these between-group differences in response times in terms of children's ability to reason about conflicting mental representations is necessarily limited without an independent measure of visual discrimination. Moreover, future research may show that these between-group effects for response time occur only in within-subjects designs in which misled participants serve as their own controls. As discussed earlier, within-subjects designs may lead to a "spreading effect" whereby children may respond more slowly to control items as a function of having been misled about other items presented on the test.

Including measures of visual discrimination may eliminate some problems of interpretation. However, other difficulties of interpretation must be clarified in future research. For example, perhaps the difference in reaction time between children with higher versus slower scores on conflicting mental representation tasks is a function of differences in either IQ or mental age. Some evidence indicates that more intelligent children respond more quickly than less intelligent children on visual discrimination tasks (Nettlelbeck & Young, 1989). Further, a certain level of speed of processing at the stimulus-encoding and stimulus-differentiation phases of input may even be necessary (but not sufficient) for attaining normal levels of cognitive development (Wilson et al., 1992). However, other research shows that response times in visual discrimination tasks are not related significantly to IQ or mental age, after controlling the negative relation between response time and chronological age (Nettelbeck & Wilson, 1994). Thus, the findings are inconsistent with respect to whether or not intelligence is related to response times

associated with speed of stimulus encoding and stimulus differentiation. Moreover, they do not at all address whether IQ may be related to the memory comparison process that was hypothesized to differ in the present study as a function of differences in representational understanding.

The possibility that differences in either IQ or mental age mediated the present results is refuted by the finding that children who were better able to reason about conflicting mental representations, who may be generally brighter, and thus faster information processors, were the children who performed more slowly on the recognition test. Further, several lines of evidence indicate that theory of mind performance is not related to general intellectual ability, although a certain level of verbal skill may be necessary for performing well on standard theory of mind tasks. For example, performance on false-belief tasks is related to measures of verbal skill typically used to assess IQ, but not significantly related to performance on measures used to assess nonverbal working memory on the Stanford-Binet (Jenkins & Astington, 1996). Further, children with autism who have borderline to normal IQs, but impaired social skills, do not perform well on most theory of mind tasks. However, children with William's Syndrome who have good social and linguistic skills, but below normal IQs, perform as well as children with normal IQs on theory of mind tasks (see Baron-Cohen, Tager-Flusberg, & Cohen, 1993, and Hobson,1993, for further discussion). This research indicates that performance on theory of mind tasks indexes the acquisition of a more specific, perhaps modular, social cognitive skill rather than general intelligence. Thus, differences in

reaction-time in the present study are unlikely to be a function of links between theory of mind performance and IQ.

The goal of this research was to examine global relations between theory of mind performance and suggestibility as a first step toward obtaining evidence concerning the predictions specified in the active mind model. Additional research is needed to examine the specific predictions of the model and to correct various limitations of the present study that may have precluded the detection of even stronger relations between theory of mind performance and reductions in suggestibility. One limitation of this research is that very few children adequately demonstrated an ability to reason about conflicting mental representations. Only 13 children in the sample met the set criterion of answering questions concerning conflicting mental representations correctly more often than would be expected by chance. Low performance on conflicting mental representation tasks resulted in the inclusion of only 22 children who were more accurate than chance on the composite measure of theory of mind performance, as compared to 35 children who performed at or below chance on that measure.

These results are surprising because the mean age of children in this study was 52 months, and one-half of the children were older than 54 months of age. The literature on theory of mind indicates that a majority of 4-1/2-year-olds pass the false-belief, appearance-reality, and representational change tasks used in this study (for a review see Astington, 1993). The number of children who failed to clearly demonstrate an ability to reason about conflicting mental representation may have attenuated relations between

theory of mind performance and suggestibility. Moreover, this research did not support the hypothesis that children who were able to reason about conflicting mental representations would have longer response times in the misleading tests than in the control condition. The restricted range in performance on conflicting mental representation tasks may have led to the equivalent reaction times found between the misleading tests and the control test.

The present results were inconsistent with other research in which 3- to 5-year-olds' understanding of conflicting mental representation predicted reductions in suggestibility after controlling for age and children's memory performance when they were not misled (Welch-Ross et al., in press). One reason for the weaker findings in the present research is that children in this study did not perform as well on the conflicting mental representation tasks. However, another explanation for the discrepancy between the two investigations concerns the different tasks used in each study to index children's understanding of conflicting mental representation. Researchers have argued on conceptual grounds that interrelations should be expected among some of the theory of mind tasks used in this research. Several studies confirm, to more or lesser degrees, that this claim is accurate, although researchers propose different reasons for their intercorrelations (Gopnik & Astington, 1988; Gopnik & Wellman, 1994; Harris, 1994; Wimmer, Hogrefe, & Perner, 1988). Consistent with previous research, significant correlations were obtained among the different theory of mind tasks in this study. However, despite their intercorrelations, theory of mind tasks are also assumed, both in

the present research and in the theory of mind literature, to tap different types of representational understanding. This claim is not as well-grounded empirically and support for it is critical for testing the specific predictions of the active-mind model. Clearly, research is needed to ascertain the validity of each index of representational understanding relevant to the model in order to reliably determine the relations among theory of mind performance and suggestibility in future work.

Research on children's theory of mind is also needed to clarify the order of acquisition of the different types of representational understanding. Although inferences concerning order of acquisition have been made across studies, developmental patterns have not been confirmed within the same sample. The results of such research could help determine if some of the pathways depicted in Figures 1 and 2 are more feasible than others. For example, Figure 2 shows that even though children are able to reason about conflicting mental representations, they may be unaware of specific mind-world connections. In this case, children who lack the prerequisite metacognitive understanding for source monitoring must guess on the recognition task.

However, future work may confirm that there are significantly more children who understand specific mind-world connections prior to being able to reason about conflicting mental representations than there are children who show the reverse pattern. In this case, the paths shown in Figure 1 indicating that children must guess on the recognition test because they do not have the metacogntive skills necessary for source monitoring would be less plausible than the pathways that follow from children's ability to understand the

specific origins of their knowledge. Similar work on the other aspects of representational understanding critical to the model would clarify alternatives among the remaining pathways.

Another critical test of the model will be to determine if an understanding of specific mind-world connections is necessary for engaging in the process of source monitoring. The only research that directly addresses this issue is a study in progress for which data are available for 21 participants. Preliminary results show that, after controlling for age, children's ability to determine the specific origin of one's knowledge is related to their ability to determine the origin of their memories for actions they had performed, pretended, or imagined (Welch-Ross, 1996a).

In related research, a series of experiments were performed with 3- to 5-year-olds in which children determined the origin of their memories for information they obtained through seeing, hearing, imagining, and inferring (Woolley & Bruell, 1996). An immediate test of children's ability to discriminate the sources of their memories was presented first and a second test followed a 10-minute delay. The results showed that children who initially encoded source information were able to remember it later, although additional data indicated that younger children experienced specific types of source monitoring difficulties at retrieval (Exp. 3).

In contrast to most studies of source monitoring in preschoolers, the 3-year-olds in Woolley and Bruell's research performed quite well (e.g., 75% correct as compared to 98% correct for 5-year-olds in Exp. 1) and the children as a group performed above

chance levels on most of the tasks. However, consistent with the literature on source monitoring, performance levels differed according to the degree of similarity between the sources. For example, differentiating memories that originated from two internal sources (e.g., imagining versus inferring) proved more difficult than differentiating memories that originated from an internal source and an external source (e.g., imagining versus hearing). The authors suggest that, if the ability to understand specific connections between experiencing and knowing is critical for source monitoring, then 3-year-olds, who are typically unable to explain how they obtained their knowledge, should not have performed as well as they did in their study. Further, the authors emphasize that the ability to understand the relation between specific experiences and knowledge has been portrayed in the theory of mind literature as an abrupt developmental transition. Therefore, if this metacognitive understanding is essential for source monitoring, the development of source monitoring skills should also emerge as skill that either can or cannot be performed, rather than as a skill that can be performed well in some contexts, but not others.

What implications might these findings have for research on suggestibility? First, the 3-year-olds in their study may have been using strategies for determining the origin of their memories other than examining their memories for distinguishing source cues, thus accounting for their surprisingly good performance (see Woolley & Bruell, 1996, for a discussion). Second, research clearly shows that an understanding of the specific relations between experiencing and knowing is not characterized by an abrupt shift from completely failing to completely passing tasks that assess children's ability to distinguish the origins of

their knowledge (e.g., Gopnik & Graf, 1988; O'Neill & Gopnik, 1991; for related discussions on the continuous development of theory of mind understanding see Flavell, Flavell, & Green, 1989; Jenkins & Astington, 1996). Further, the prediction following from the active-mind model that the understanding of specific connections between experiencing and knowing is necessary for source monitoring is consistent with findings indicating that young children may be able to monitor the sources of their memories only in some contexts. Thus, studies are needed to determine if children who may be in a point of transition in the understanding of specific mind-world connections may be able to monitor the sources of their memories in some situations, but not in others.

Consider that the ability to engage in source monitoring does not guarantee that individuals will examine their memories for source cues. They may neglect to do so for a variety of reasons that may be either developmental (e.g., newly acquired strategies for remembering are too effortful to execute) or contextual (e.g., the appropriate cues for encouraging source monitoring may not be encountered in some contexts but will be in others). For example, adults who do not spontaneously engage in source monitoring, but who are encouraged to do so through explicit instructions, are better able to distinguish the origin of their memories than adults who do not receive explicit instruction. Adults who are encouraged to engage in source monitoring are less suggestible. This finding has been obtained in research conducted in laboratory settings (Lindsay, 1990; Lindsay & Johnson, 1989) and in research evaluating standardized interviewing methods used forensic contexts. For example, the use of structured interviews in which witnesses are

encouraged to examine their memories for source cues results in more accurate memory reports (e.g., Morton, 1994).

Such contextual support may be particularly important for preschoolers who are in a transitional phase in their understanding of specific mind-world connections. Future work may involve experimental manipulations in which children who either pass or fail specific mind-world connection tasks are either given a standard recognition task or are explicitly instructed to distinguish the sources of their memories after being misled. The results of such studies will help determine if children with poorer source monitoring skills lack the prerequisite metacognitive understanding for source monitoring or whether they lack sufficient contextual support. The findings may show that children who are in a period of transition in their understanding of the specific connections between experiencing and knowing may be most likely to benefit from explicit instruction and, therefore, experience the most dramatic reductions in suggestibility. Alternatively, if an understanding of knowledge must be fully developed before source monitoring can take place, children without this understanding of knowledge would not benefit from such instruction, and would be more likely to be misled.

Finally, the current model focuses on the suggestibility of young children, although both adults and children are suggestible. However, the accuracy with which adults report their memories of witnessed episodes is the standard against which children's memory reports are judged. In order to address the practical consequences of children's suggestibility stemming from developmental differences in understanding the

representational mind, comparisons must be made between the memory reports of preschoolers and adults to determine if children's understanding of the mind plays a critical role in reducing their accuracy below the adult standard.

Conclusion

Suggestibility is believed to occur as a function of a combination of cognitive and social factors that may act either separately or in interaction to diminish the accuracy of individuals' reported memories (Ceci & Bruck, 1993; Schooler & Loftus, 1993). Many opportunities for exposure to misinformation arise whenever children witness a crime and must report the details during repeated forensic interviews, discussions with concerned parents, and interviews with medical staff and mental health professionals. Research targeted toward determining the mechanisms underlying preschoolers' suggestibility will lead not only to a better understanding of the phenomenon of suggestibility itself, but also to the development of methods for eliciting information that are consistent with young children's level of cognitive and social development. The present research provided evidence concerning social cognitive skills that develop during the preschool years that may help children resist inaccurate information that is suggested to them. As children come to understand the mind as an active, representational information processor they may be better able to evaluate the validity of conflicting information originating from different sources, thereby improving the accuracy of their memory reports.

APPENDIX A

SAMPLE OF DIGITIZED STIMULI FOR RECOGNITION TEST

APPENDIX B

STORY SERVING AS WITNESSED EVENT

This is a story about John and Amy. This is the house where Amy and John live. Today was very special because it was Amy's birthday. So, Amy's father made her favorite eggs for breakfast. After breakfast, John fed his pet dog. Then, the mailcarrier bought Amy a big birthday present from Grandma. John wrapped the present he bought for Amy--a stuffed monkey. Then, John made some cupcakes for Amy's birthday party. Amy went outside and blew bubblegum bubbles. Soon it was time for the party. John wore his favorite baseball hat to the party. At the party, Amy's friends played with her brand new building blocks. Then, everyone went outside to play in the sandpile. John made lots of castles in the sand. After everyone went home, Amy and John hopped on their skates and raced to the park. On the way to the park, they saw a horse eating grass in a field. At the park John saw some ducks in the pond. Then, John played with his basketball. Amy fell off the junglegym at the park, but she was okay. John and Amy became very hungry. They went home and ate bananas for their snacks. Then, Amy drew a picture of a moon with a smiling face. John watered flowers in the garden. Soon it was time for dinner so Amy and John helped make hotdogs. After dinner, Amy played her drums really loud. John played with his toy airplane. It was time for bed and Amy and John need baths. Amy played with her toy fish in the bathtub. John put on his Mickey Mouse pajamas. That night, Amy had silly dreams about dancing dolls.

APPENDIX C

INTERVIEW

Control Questions

1. Did John feed his pet dog after breakfast?
2. Did Amy draw a picture of a star with a smiling face?
3. Did John make castles in the sand?
4. Did John put on his Mickey Mouse pajamas?
5. Did Amy and John see a cow eating in a field?
6. Did John and Amy help make hamburgers for dinner?

Misleading Questions

7. Amy played her piano really loud, didn't she?
8. Amy's father made her favorite pancakes for breakfast, right?
9. John played with sailboats in the pond, didn't he?
10. John played with his toy truck, didn't he?
11. Amy's Aunt Emily called to wish Amy a happy birthday, right?
12. John wore his favorite cowboy hat to the party, didn't he?
13. Amy's friends played with her brand new playdough, didn't they?
14. Amy had silly dreams about dancing clowns, didn't she?
15. Amy played with her toy frog in the bathtub, right?

16. Amy blew soap bubbles, didn't she?

17. John picked flowers in the garden, right?

18. Amy fell off the seesaw at the park, right?

Control Questions

19. Did John make cupcakes for the party?

20. Did Amy and John hop on their bikes and race to the park?

21. Did John play with a jumprope at the park?

22. Did John and Amy eat grapes for their snacks?

23. Did John wrap a stuffed monkey to give to Amy?

24. Did the mailcarrier bring Amy a big birthday present?

APPENDIX D

THEORY OF MIND TASKS

General Mind-World Connection

1. The child looked into a box to see its contents. The researcher closed the box, introduced Puppet Ernie, and asked, "Do you know what is inside the box? Does Ernie know what is inside the box?" Another trial was presented in which Ernie looked inside, but the child did not look. The child and Ernie each looked inside for 2 trials. The items placed inside the box include a book, a pen, a doll, and a crayon. Children were required to produce the correct "no - yes" sequence of responses to receive a point for each trial. Whether Ernie or the child looked inside first was alternated between subjects. Scores ranged from 0 to 4.

2. Puppet Bert was presented. His eyes and ears were covered. The researcher emphasized that Bert could not see or hear anything. The researcher presented a picture of a giraffe and an elephant and children identified the animals. Children were told, "I'm going to show this picture to Bert, but first I'm going to cover the picture so that Bert sees only a little part of it. Bert has never seen this picture before." The cover was placed over the picture and Bert's blindfold was removed. Children watched as Bert was shown the following ambiguous or informative views of the picture: an "empty" view in which no part of the animals was visible, an unidentifiable part of one of the animals, unidentifiable

parts of both of the animals, an identifiable part of one of the animals. After each view was presented, children were asked, "Does Bert know if there's an elephant in the picture?" "Does Bert know if there's a giraffe in the picture?" The order of these questions was counterbalanced within subjects. Children received 1 point for the correct pattern of responses for each of the 4 trials. The same testing and scoring procedures were repeated for a picture of a flower and a bee. Scores ranged from 0 to 8. Total scores for general mind-world connections tasks ranged from 0 to 12.

Specific Mind-World Connections

Children discovered the contents of a bag by either looking inside or being told about the contents. Each child received two "look" and two "tell" trials. "Look" and "tell" trials were counterbalanced within subjects. Whether children looked inside first or were told the contents first was counterbalanced between subjects. For each trial, children were asked, "What is inside the bag?" and then the test question, "How do you know what's inside?" If children did not answer, or replied "I don't know," they were prompted, "Did I tell you what's inside, or did you see what's inside?" The order of alternatives was counterbalanced within subjects. Only children's unprompted responses were analyzed to provide the most stringent criterion for assessing children's ability to identify the specific origin of their knowledge. Scores ranged from 0 to 4.

Conflicting mental representation

Crayon box. The researcher presented a closed crayon box and asked, "What do you think is inside the box?" Then, the researcher opened the box and asked, "What is

inside the box?" The researcher closed the box and asked the test questions.

Representational change: "When you first saw the box, all closed up like this, what did you think was inside the box, crayons or candles?"

False-belief: The researcher presented Puppet Ernie and let Ernie "look" at the outside of the box. "Ernie has never looked inside the box. What does Ernie think is inside the box, candles or candles?"

Toy car. The researcher presented Puppet Bert, a box, and bag. The child watched as the researcher enacted the following story with the puppets. "Bert is putting his toy car inside the bag. Now he's going outside to play. Here comes Bert's friend Kermit. Kermit is taking the toy car out of the bag and putting it inside this box. Now Kermit is going home." The researcher asked the test questions.

False-belief: When Bert comes back inside, where will he look for the car, inside the box or inside the bag?"

Representational change: "Now I'm going to show Bert where the car is. When Bert came inside from playing, before I showed him the car, where did he think the car was, inside the bag or inside the box?

Rock-sponge[1]. The researcher presented a rock that looked like a sponge. "Look at what I have. Here, you can touch it." Then, she asked the test questions.

Appearance-reality: What does this look like to your eyes right now? Does it look like a rock or does it look like a sponge? What is this really? Is it really a sponge or is it really a rock?

Representational change: When you first saw this, before you squeezed it, what did you think it was, a rock or a sponge?

False-belief: Kermit has never touched this before. What does Kermit think this is, a sponge or a sponge?

Appearance-reality: The researcher presented a white paper cut-out of a fish and asked "When you look at this fish with your eyes right now, does it look red or does it look white?" Then, the researcher placed a red filter over the fish and asked, "When you look at this fish with your eyes right now does it look white or does it look red?" While the filter remained over the fish the researcher asked the test question, "What color is this fish really and truly? Is it really and truly white or really and truly red?" The order of alternatives was counterbalanced within and between subjects.

Appearance-reality: The above procedure was repeated with a white cut-out of a butterfly and a blue filter. Scores for each set of representational change, false-belief, and appearance-reality tasks each range from 0 to 3.

Total scores for conflicting mental representation tasks ranged from 0 to 9.

Memory Representation (Conflicting Mental Representation in the Context of Memory)

The researcher read the following four stories with accompanying pictures:

a) [picture of a boy playing ball outside] This is Charlie. Charlie is throwing that ball. Charlie is remembering when his puppy was outside with him. [picture of puppy inside]. He knows his puppy isn't outside anymore, its in the house, see. But Charlie is

remembering when his puppy was outside with him. ["thought" pictures] Right now, while Charlie is remembering, which of these pictures do you think is inside his head?"

b) [picture of girl in sand box] This is Tanisha. Tanisha is holding a water pitcher. She is putting sand inside of it. She is remembering when there was water inside the pitcher. [picture pouring sand] She knows that there's not water inside there anymore, there's sand inside, see? But Tanisha is remembering when there was water inside. ["thought" pictures] Right now, while Sue is remembering, which of these pictures do you think is inside her head?

c) [picture of Sue in bed] This is Sue. Sue is staying at her grandma's house Sue is remembering when her teddy bear was in the bed with her. She knows that her teddy bear isn't with her anymore. [picture of teddy at home] Its really at home in her own bedroom, see? But Sue is remembering when her teddy bear was in bed with her. ["thought" pictures] Right now, while Sue is remembering, which of these pictures do you think is inside her head?

d) [picture of fish and a boot in a lake] Look at all of these fish in the water. And look, there's a boot too. [picture of Fred with a boot on the end of the pole] This is Fred. Fred is holding a fishing pole. Fred is remembering when he had a fish on his hook. He knows there's not a fish there anymore, now there's a boot, see. But Fred is remembering when there was a fish on his hook. ["thought" pictures] Right now, while Fred is remembering, which of these pictures do you think is inside his head?

Scores ranged from 0 to 4.

Note

1. This task was repeated using a candle that looked like an apple. However, the task was omitted because most children did not label the candle correctly while they were feeling it, and therefore they could not be asked the test questions.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the Doctor of Philosophy.

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